

From: (b) (6), (b) (7)(C)
To: (b) (6), (b) (7)(C)
Cc: (b) (6); (b) (6), (b) (7)(C)
Subject: FW: Andrade Fence Repair - 90% Submittal
Date: Friday, November 02, 2012 4:18:45 PM
Attachments: [Andrade Fence Repair 90% Submittal SOW & Provisions 100312.pdf](#)
Importance: High

(b) (6), (b) (7)(C) and (b) (6), (b) (7)(C)

Copy of the Andrade SOW created by the Corps.

(b) (5)

More discussion on Tuesday.

Thanks.

(b) (6), (b) (7)(C), CBM, PMP
Division Director, TI Division
Border Patrol Facilities and Tactical Infrastructure
Program Management Office
Facilities Management and Engineering
Office: (b) (6), (b) (7)(C)
Cell: (b) (6), (b) (7)(C)
(b) (6), (b) (7)(C)

Excel as a trusted strategic partner enhancing Border Patrol's proud legacy.

From: (b) (6), (b) (7)(C)
Sent: Thursday, October 04, 2012 7:36 AM
To: (b) (6), (b) (7)(C); (b) (6)
Cc: (b) (6), (b) (7)(C)
Subject: FW: Andrade Fence Repair - 90% Submittal

(b) (6), (b) (7)(C)

FYSA – Baker's on schedule with their commitment of deliverables for Andrade.

(b) (5)

S.

(b) (5), (b) (6); (b) (7)(C)

(b) (6), (b) (7)(C)

(b) (6), (b) (7)(C)
Branch Chief - TI Division Projects, Maintenance and Repair
Border Patrol Facilities and Tactical Infrastructure
Program Management Office
Facilities Management and Engineering
Office: (b) (6), (b) (7)(C)
Mobile: (b) (6), (b) (7)(C)

(b) (6), (b) (7)(C)

Excel as a trusted strategic partner enhancing Border Patrol's proud legacy.

From: (b) (6)
Sent: Wednesday, October 03, 2012 9:08 PM
To: (b) (6) (b) (6), (b) (7)(C) (b) (6) (b) (6), (b) (7)(C) (b) (6)
(b) (6) (b) (6) (b) (6) (b) (6)
(b) (6) (b) (6)
Cc: (b) (6), (b) (7)(C)
Subject: Andrade Fence Repair - 90% Submittal

Hello,

We are pleased to provide the 90% submittal for the Andrade Fence Repair Project for your review and comment. Attached to this email you will find the 90% SOW & Provisions which includes the following documents:

1. 90% Construction Plans
2. Access & Staging Map
3. 90% Construction Specifications
4. Geotechnical Testing Results

We will follow up tomorrow with the project cost estimate, as we are making a few adjustments based on the attached documents.

Please return any comments you may have by COB this Friday using the attached spreadsheet and I will have them compiled for use on the upcoming comment resolution call. Also, please pass this on to anyone who needs to review, but I did not include them on the distribution.

If you have any questions, please feel free to contact me.

Thanks,

(b) (6)

(b) (6), PE
Technical Manager
Michael Baker Jr., Inc.
2929 N. Central Ave., Suite 800
Phoenix, AZ 85012

Front Desk: (b) (6)
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ANDRADE PRIMARY FENCE REPAIR
OFFICE OF BORDER PATROL, YUMA SECTOR
CUSTOMS AND BORDER PROTECTION
DEPARTMENT OF HOMELAND SECURITY

PART I

GENERAL SCOPE OF WORK PROVISIONS

- 1.1.1. Scope of Work. The work in the base portion of this contract shall consist of furnishing all labor, tools, equipment, materials, supplies, and personnel necessary for the construction of replacement fence for the portion of the Andrade fence (C-1) that was undermined and collapsed along the International Border between the U.S. and Mexico within the Yuma Sector, Yuma Border Patrol Station in Imperial County, California as described and in accordance with the attached exhibits and specifications and the attached clauses and instructions for a period of 60 days from Notice to Proceed. This section is referred to as Area 2 within the attached exhibits.

The work in Option 1 of this contract shall consist of furnishing all labor, tools, equipment, materials, supplies, and personnel necessary for the stabilization of existing fence for the portion of the Andrade fence (C-1) immediately to the east of Area 2, henceforth known as Area 3, within the Yuma Sector, Yuma Border Patrol Station in Imperial County, California as described and in accordance with the attached exhibits and specifications and the attached clauses and instructions for a period of 45 days from Notice to Proceed.

The work in Option 2 of this contract shall consist of furnishing all labor, tools, equipment, materials, supplies, and personnel necessary for the stabilization of existing fence for the portion of the Andrade fence (C-1) immediately to the west of Area 2, henceforth known as Area 1, within the Yuma Sector, Yuma Border Patrol Station in Imperial County, California as described and in accordance with the attached exhibits and specifications and the attached clauses and instructions for a period of 45 days from Notice to Proceed.

- 1.1.2. Duration of Contract. The length of the base portion of this contract is for 60 days starting at the date of Notice to Proceed. The length of Option 1 of this contract is for 60 days starting at the date of Notice to Proceed. The length of Option 2 of this contract is for 60 days starting at the date of Notice to Proceed
- 1.1.3. Safety. The Contractor shall be responsible for instructing his workers in appropriate safety measures. The Contractor and his personnel shall adhere to all safety requirements as outlined in "U.S. Army Corps of Engineers Safety and Health Requirements Manual," EM 385-1-1, 15 September 2008. Failure to compile with EM 385-1-1 could result in the stoppage of work by the Contracting Officer.
- a. Accident Prevention Plan and Activity Hazard Analysis. The successful bidder shall be responsible for completing an Accident Prevention Plan covering the contract and an Activity Hazard Analysis for each activity taking place during the contract which is acceptable to the Contracting Office and the Safety Office of the Los Angeles District prior to commencement of any work as called for in EM 385-1-1, paragraph 01.A.07 and 01.A.09, and Appendix A.
 - b. Monthly Safety Meetings. At least one safety meeting shall be conducted monthly by the Contractors Representative for all workers as called for in EM 385-1-1, paragraph 01.B.03.

Information on the monthly safety meeting shall be reported on SWG Form 392, Minutes of Safety Meeting, and submitted at the end of each month as required in paragraph 1.1.18d.

- c. Exposure and Accident Reporting. The Contractor shall keep records of all time worked and all injuries and accidents which occur during the performance of this contract. Exposure information (time worked) shall be reported on SWD Form 743, Monthly Exposure Report, and submitted at the end of each month as required in paragraph 1.1.18d. The Contractor shall report any accident or injury which may result in a permanent disability or fatality to the Contracting Officer immediately. Any accident or injury involving the general public shall be reported to the Contracting Officer immediately. Any accident or injury which result in a visit to a doctor, hospital, or involves a lost work day, or involves property damages of over \$500 shall be reported to the Contracting Officer no later than the next work day. The Contractor shall be responsible for keeping records on all injuries no matter how minor requiring first aid treatment. Accident information shall be reported on SWD Form 517, First Aid Case History Report, and submitted at the end of each month as required in paragraph 1.1.18d. Additional information may be found in EM 385-1-1, paragraph 01.D. In addition to the accident reporting requirements listed above, the Contractor shall inform Border Patrol within four hours after any accident that involves Border Patrol personnel or property, the necessity of EMS, media involvement or any damage to private property.
- 1.1.4. Security. It shall be the Contractor's responsibility to furnish security for personnel and to safeguard material, equipment, etc. as the need is determined by the Contractor. This will include but not limited to actual project sites, and or staging areas and storage facilities. The Customs and Border Patrol will not provide security for the contractor. The Border Patrol agents shall respond to routine security matters/threats if and when they occur. Both the Contractor and Border Patrol shall provide phone numbers to be used in emergency situations. As a part of the security requirement, the Contractor shall be responsible for the development of a Security Plan in conjunction with the Health and Safety Plan. The detailed Security Plan shall include details such as, but not limited to; "fall back positions", evacuation routines and methods, muster area, medical staff members/availability, number of security personnel, qualifications, years of experience, etc. in the event of a hostile attack. This plan shall be reviewed by USACE Safety and Security Officers for inspection and final acceptance prior to activities. The Contractor shall bring three (3) copies of the security plan to the post-award coordination conference.
- 1.1.5. Damage Responsibility. The Contractor shall be responsible for restoring any government facilities, structures, or trees damaged as a result of his operations. He shall also be responsible for any damage to private and/or personal property and/or injury to any person as a result of his operations. The Contractor shall notify the Contracting Officer immediately of any such damage or injury.
- 1.1.6. Contractor Liaison. Beginning on the date of Notice to Proceed (NTP) on this Task Order, the Contractor shall be continuously available to the U.S. Army Corps of Engineers' representatives for response to requests for information, discussion of contract performance, and other contract administration activities such as billing or payment, etc.
 - a. FOR EMERGENCY CIRCUMSTANCES ONLY: The Contractor shall provide the names, job titles, and contact information, to include telephone numbers (business, cell phones, facsimile, pager numbers, etc.) of a senior manager within the Contractor's organization, and a minimum of one similarly qualified alternate to serve as continuously available liaison with the USACE. The Contractor shall submit the above information to the Contracting Officer by email within two calendar days following receipt of the Task Order award. During the contract period, the Contracting Officer and the Contracting Officer's Representative (COR) shall be notified immediately, by email, of any changes regarding the designated liaisons.
- 1.1.7. Contractor's Personnel. All personnel used in the performance of this contract shall be well trained in the task they actually perform. All members of the Contractor's crew who are participating in

construction activities must have completed background checks and obtained appropriate clearances as detailed in Section H.

a. Contractor's Representative. The contractor shall designate a responsible representative in charge of the work who shall be at the work site during all hours worked by the Contractor's personnel or a Sub-Contractor's personnel. This representative shall be knowledgeable in the work to be performed and shall be able to represent the Contractor during any on-site discussions concerning this contract. He/she shall be able to communicate knowledgeably in English.

b. Sub-Contractors. All sub-Contractors used in the performance of this contract shall be qualified in the work which they perform. All Sub-Contractors shall abide by all conditions of the contract. The use of a Sub-Contractor does not relieve the Contractor of any responsibilities of this contract. The Contractor shall obtain approval for the use of a Sub-Contractor from the COR prior to using the Sub-Contractor.

1.1.8. Non-Disclosure. Neither the Contractor, nor the Contractor's representatives, shall release any report, data, specification, photograph, cost estimate, nor other information in any form obtained or prepared under this contract without prior written approval of the Contracting Officer.

1.1.9. Discrepancies. Any discrepancies found in the contract documents by the offeror shall be identified to the Contracting Officer before the submittal of the offeror's proposal. The offeror is solely responsible for the content of the proposal and its compliance with all contract requirements and all referenced codes and criteria.

1.1.10. Work Schedule. Work on this contract shall be performed between the hours of 6:00 AM to 6:00 PM, Monday through Friday excluding federal holidays.

1.1.11. Work Plan. The Contractor shall submit a Work Plan that includes, but is not limited to a list of equipment, staging area locations, location of disposal, dust control, schedule, capacity and dimensions of haul trucks, quantity of material expected per truck, etc.

1.1.12. Work Limits and Access to Work Site. All work, including construction, staging, hauling, ingress and egress, shall be limited to areas of Government owned property, areas the Government has obtained easements, and areas the Government has an appropriate property interest. The project corridor, staging area and ingress/egress limits are shown on the map located in Appendix 2. The Contractor shall ensure all materials, equipment, vehicles, personnel and any other construction related items and/or activities be contained within the work limits. The Contractor shall coordinate with the local Border Patrol station for access to the work site. The Contractor shall ensure, to the extent possible, that the patrol road is not blocked due to construction activities. Additionally, the Contractor shall not enter Mexican land or airspace with personnel or equipment.

1.1.13. Invoicing and Payment. The Contractor shall invoice for work according to the Price Schedule found within this contract. Lump Sum items shall be invoiced on a percent complete at the time of the invoice. The Contractor shall provide description of work completed up to the date of the invoice with each invoice. Payment will be made on a monthly basis for all work completed during that month and only for work that has been inspected and accepted as described in paragraph 1.1.12 above. The copy of the invoice as required in Paragraph 1.1.18d, will be compared against the daily reports for verification of all work before payment is made. All submittals as required in paragraph 1.1.18d, for that month shall also be provided before payment is made.

The Contractor shall not receive final payment until all identified punch list items are resolved and final "as-built" information is approved and delivered to the COR.

1.1.14. Contracting Officers Packet of Information. After the apparent Contractor has been selected and before work commences, the COR shall provide the Contractor with a packet of information

containing:

- a. An EM 385-1-1, Safety and Health requirements Manual,
- b. Examples of an Accident Prevention Plan and an Activity Hazard Analysis,
- c. Fifteen SWG Forms 407, Safety Inspection Checklist,
- d. Thirteen SWD Forms 743-J, Monthly Exposure Report,
- e. Thirteen SWG Forms 392, Minutes of Safety Meetings,
- f. Thirteen SWD forms 517, First Aid Case History Report,
- g. Two ENG Forms 3394, Accident Investigation Report,
- h. A supply of daily reports,
- i. Three monthly submittal registers.

If additional forms are needed the Contractor shall contact the Contracting Officer. The Contractor may use forms which he/she has developed if approved by the Contracting Officer.

- 1.1.15. Pre-Construction Meeting. On a mutually agreed upon date, the Contractor shall be required to attend a Pre-Construction Meeting where he will meet with the COR as well as other officials having an interest in the contract. At this time the Contractor shall provide the COR with all required submittals and discuss the contract. If the COR is satisfied with all submittals and feels that the Contractor is qualified to perform the work the Contractor may then begin work.

1.1.16. Submittals.

a. At the Pre-Construction Meeting the apparent Contractor shall be required to submit the following information to the COR:

(1) A letter containing:

- (a) A statement acknowledging full understanding of the contract plans and specifications.
- (b) A list of references for which the contractor has performed similar work previously,
- (c) The name and qualifications of the Contractor's representative,
- (d) The name and qualifications of any sub-contractors which the Contractor plans to utilize and a description of the work the sub-contractor shall perform.

If information changes during the contract period, the Contractor shall inform the Contracting Officer in writing at least fifteen (15) days in advance of these changes or when additional information becomes available.

- (2) Certification of roll-over protection,
- (3) Proof of insurance,
- (4) Accident Prevention Plan and Activity Hazard Analysis,

- (5) Work Plan
- (6) Security Plan
- (7) Project Schedule
- (8) Crane Critical Lift Plan
- (9) Proof of Qualification for Crane Operators
- (10) Quality Control Plan
- (11) Environmental Protection Plan
- (12) Waste Management Plan

b. The Contractor shall be responsible for constructing new fencing, stabilization measures and associated project components per the construction plans (See Appendix 1) and technical specifications (See Appendix 3). Prior to start of construction, the Contractor shall submit shop drawings and other such information to the COR for review and approval. The following list of shop drawings is provided for the Contractor's convenience and does not necessarily represent all required shop drawing submittals. The Contractor shall also review the technical specifications for other miscellaneous submittal requirements.

- Demolition Plan, G
- Survey layout, G
- Crane Plan, G
- Drilled Shaft Plan, G
- Concrete Mix Designs, G
- Precast Retaining Wall Manufacturer's Specifications, G
- Pre-cast Retaining Wall Layout & Details, G
- Structural Steel, G
- Weld Qualifications, G
- Reinforcing Steel, G
- Trenching Plan, G

c. At the end of each work day or on the morning of the following day the Contractor shall submit a completed daily report and geospatial data collection report. After an inspection of the work covered by the daily report, the COR will sign the report and return a copy of it to the Contractor. Any deficiencies in the work or discrepancies between the daily report and the inspection will also be noted. Attached to the daily report shall be the SWG FORM 407, "Safety Inspection Checklist for Equipment" as discussed in paragraph 1.2.2a, for all equipment put into service on that day.

d. At the end of each month in which work is performed the Contractor shall submit a properly certified invoice containing Contractors name and address as shown on the contract, the contract number, the period covered by the invoice, and an itemized listing of work performed during the invoice period to:

USACE, Finance Center
7800 Third Avenue
Attn: Mail Stop 322
Millington, Tennessee 38054-8001

e. At the end of each month in which work was performed the Contractor shall make the following submittals to the COR at :

Location To Be Determined

- (1) Submittal register,
- (2) A copy of the invoice submitted to the USACE Finance Center,
- (3) SWD Form 743-J, Monthly Exposure Report,
- (4) SWG Form 392, Minutes of Safety Meeting,
- (5) SWD Form 517, First Aid Case History Report,
- (6) ENG Form 3394, Accident Investigation Report, if necessary.

The COR may require additional submittals if necessary without any change in the contract price.

1.1.17. Storage of Equipment and Materials. The contractor shall be responsible for finding a location to store their equipment and materials. Any equipment or material stored shall be maintained in a neat and orderly fashion to the satisfaction of the COR. The Corps of Engineers and Border Patrol shall not be responsible for the protection of any equipment or material. The COR shall reserve the right to require the immediate removal of any and/or all equipment and material if deemed in the best interest of the government.

1.1.18. .

1.1.19. Contractors Inspection. The Contractor inspection date and time can be found at FAR 52.236-27 ALT 1 within this RFQ.

1.1.20. Geospatial Data Collection. The Contractor shall submit geospatial data collection report per paragraph 2.1.14.

1.1.21. Final Inspection and Acceptance of Work. The Contractor shall be responsible for coordinating and conducting a punch list walk through of the project in conjunction with the COR and Customs & Border Protection representative. The Contractor shall generate the punch list of all items identified and agreed upon by all parties during the walk through. The final walk through shall be conducted once the punch list items are complete. The Contractor shall be responsible for coordinating and conducting the final walk through with the COR and Customs and Border Protection representative no later than 14 calendar days following the punch list walk through.

PART II**SCOPE OF WORK TECHNICAL PROVISIONS**

- 2.1.1. Scope of Work. The work in the base portion of this contract shall consist of furnishing all labor, tools, equipment, materials, supplies, and personnel necessary for the construction of replacement fence for the portion of the Andrade fence (C-1) that was undermined and collapsed along the International Border between the U.S. and Mexico within the Yuma Sector, Yuma Border Patrol Station in Imperial County, California as described and in accordance with the attached exhibits and specifications and the attached clauses and instructions for a period of 60 days from Notice to Proceed. This section is referred to as Area 2 within the attached exhibits.

The work in Option 1 of this contract shall consist of furnishing all labor, tools, equipment, materials, supplies, and personnel necessary for the stabilization of existing fence for the portion of the Andrade fence (C-1) immediately to the east of Area 2, henceforth known as Area 3, within the Yuma Sector, Yuma Border Patrol Station in Imperial County, California as described and in accordance with the attached exhibits and specifications and the attached clauses and instructions for a period of 45 days from Notice to Proceed.

The work in Option 2 of this contract shall consist of furnishing all labor, tools, equipment, materials, supplies, and personnel necessary for the stabilization of existing fence for the portion of the Andrade fence (C-1) immediately to the west of Area 2, henceforth known as Area 1, within the Yuma Sector, Yuma Border Patrol Station in Imperial County, California as described and in accordance with the attached exhibits and specifications and the attached clauses and instructions for a period of 45 days from Notice to Proceed.

- 2.1.2. Site Locations and Description. The following are descriptions of the Andrade Primary Fence Repair project corridor. See the attached exhibit for general location of the areas.

- a. Area 2 begins approximately (b) (7)(E) miles west of the Algodones port of Entry (POE) and extends approximately (b) (7)(E) feet to the east. The project consists of installing new pedestrian style bollard (P-3) fence with a reinforced concrete foundation that will connect to the existing fence and foundation on either side of the current fence opening. To support the new fence and reduce the risk of future damage on the south side of the fence, a modular concrete block retaining wall will be installed approximately (b) (7)(E) north of International Border. The area between the fence and the retaining wall will be backfilled with (b) (5), (b) (7)(E).
- b. Area 3 begins on the east end of Area 2 and extends approximately (b) (7)(E) feet to the east, ending approximately (b) (7)(E) miles west of the Algodones POE, just west of Border Monument (b) (7)(E). Stabilization measures will consist of the installation of (b) (7)(E)-inch diameter drilled shafts spaced at (b) (7)(E)-feet (b) (7)(E) on center located approximately (b) (7)(E)-feet south of the existing fence. The area between the drilled shafts and the existing fence will be backfilled with AASHTO (b) (5), (b) (7)(E).
- c. Area 1 begins approximately (b) (7)(E) miles west of the Algodones POE and extends approximately (b) (7)(E) feet to the east, connecting to the west end of Area 2. Stabilization measures will consist of installation of (b) (7)(E)-inch diameter drilled shafts spaced at (b) (7)(E)-feet (b) (7)(E) inches on center located approximately (b) (7)(E)-feet south of the existing fence. The area between the drilled shafts and the existing fence foundation will be stabilized with a fiber reinforced shotcrete slab over compacted soil cement.
- d. See Appendix A for specific delineation of the base and option items. The specifications provided in Appendix C apply to base and option items.

- 2.1.3. Equipment. The Contractor shall have available adequate equipment in the opinion

of the Contracting Officers Representative to perform all aspects of the work described. The equipment shall be in good operating condition and be used for its intended purpose. The Contractor shall make all equipment available to the Contracting Officers Representative for inspection at any time upon request. If in the opinion of the Contracting Officer any equipment is unsafe, unsuitable, or inadequate for the work which it is to be used for, the equipment shall be removed from the job site and/or additional or replacement equipment acquired.

- a. Equipment Safety Inspection. Before any mechanized equipment is placed into service, it shall be inspected and tested by a person familiar with operations of that equipment as called for in EM 385-1-1, Paragraph 18.A.03.
 - b. Crane: The Contractor shall submit a proposed crane plan to the COR for review and approval. The crane plan shall show the proposed crane set up locations for all proposed crane activities and detail any required utility coordination. The crane plan shall also include the specific model of each crane, the dimensions, wheel sizes, number of wheels, wheel spacing, tire pressure(s), number of axles, axle spacing, minimum wheel load to be exerted during operations and maximum outrigger load to be exerted during operations. The Contractor shall allow at least 10 working days for acceptance/non-acceptance of the crane work plan. No crane operations shall begin prior to written acceptance of the crane work plan by the COR, who shall be the Government approving authority.
- 2.1.4. Existing Conditions. The Contractor, in the presence of the COR, shall document existing site conditions via video recording and photographs prior to start of construction. Documentation shall include condition of all existing roads (on-site and egress/ingress), structures, utilities and structures within and immediately adjacent to the project site. The COR will have the final approval that the documentation has been adequately completed. The Contractor shall provide a copy of all documentation on CD(s) and/or DVD(s) to the COR for the project record.
- 2.1.5. Construction Guidelines
- 2.1.5.1. All construction required of the Contractor to complete the construction of the fence shall be in accordance with the criteria contained herein using industry standard materials and efficient practices. The Contractor shall use materials and equipment accepted within the construction industry. The materials selected shall be of high quality, durable and easily maintained.
 - 2.1.5.2. The Contractor shall take great care not to disturb any existing fence outside the limits of this project unless specifically called for in the plans. If the existing fence is disturbed, it shall be the Contractor's responsibility to repair the fence so to restore it to previously existing conditions or replace it in-kind if damaged beyond repair. Should it be necessary to disturb the foundation of the existing fence, the Contractor shall be responsible for providing all bracing or means of temporary shoring so to protect the existing fence in-place.
 - 2.1.5.3. At the end of each work day the Contractor shall effectively close all fence by either erection of new fence or temporary fence until such time that work begins the following day. The Contractor may use existing fence material for temporary fence to close off gaps overnight.
 - 2.1.5.4. All egress/ingress access roads, on-site fence access roads and staging areas shall be returned to existing conditions or better prior to final acceptance of the project. This shall include providing aggregate surface course needed to enable the access roads to be bladed in order to remove ruts, depressions, and/or pot-holes caused by construction activities. See Appendix B for Access and Staging Map.
 - 2.1.5.5. Installed fence panels, over the specified lengths shown in the plans, shall be constructed vertical with an allowable tolerance of 1-inch out of plumb over the entire height of the fence. Fence coordinates shall be surveyed to within 3-inches of the coordinates provided in the plans. Any

discrepancies in dimensions, elevation, or alignment shall be brought to the attention of the COR prior to continuing with construction in the vicinity of the discrepancy. The COR reserves the right to resolve such discrepancy prior to commencing work within the vicinity of the discrepancy.

- 2.1.5.6. All fence construction materials and accessories shall have the ability to survive temperatures applicable to the southwestern border of the U.S. including diurnal and seasonal extremes with temperature deltas in excess of 120 degrees Fahrenheit.
- 2.1.5.7. All fence construction materials and accessories shall have a 30-year service life requiring planned maintenance to occur not earlier than every ten years.
- 2.1.5.8. All final grades adjacent the fence location shall be finished so drainage flows away from the fence so to prevent ponding of water at the fence and fence foundation location.
- 2.1.6. Removal and Disposal of Litter, Trash, Man-Made and Natural Debris and Vegetation. The contractor is responsible for the removal and disposal of all waste material from government property. The Contractor shall dispose of litter, trash, man-made and natural debris at an off-site location approved by the COR. The Contractor shall remove, haul and dispose of all material in accordance with all local, state, and federal laws. The Contractor shall provide all applicable licensing and/or permits for operating equipment, hauling and disposal of removed debris and vegetation. The Contractor shall keep all application and permit records as required by state, local and federal regulations. The Contractor shall supply a copy of application and permit records to the COR as soon as each application is made and permit received.

No stockpiled litter, trash, debris or vegetation shall be left unattended or overnight at the project site. All litter, trash, debris, and vegetation shall be hauled off site and disposed of at the end of each workday.

Burning is not considered an acceptable form of debris removal.

- 2.1.7. Geotechnical Investigation. The Geotechnical Report for the project site has been provided in Appendix D. Any additional Geotechnical information required by the Contractor shall be obtained by the Contractor following award of bid.
- 2.1.8. Survey. All survey performed by the Contractor, including but not limited to construction staking and as-built drawings, during construction shall be performed under the direction of a licensed professional Surveyor.
- 2.1.9. Temporary Traffic Control Measures. The Contractor shall be required to provide all traffic control measures required per local codes.
- 2.1.10. HAZARDOUS WASTE. Hazardous waste is not anticipated as a part of this action. Should hazardous waste be discovered, the Contractor shall stop work immediately at the location in question and refer to the COR for consultation.
- 2.1.11. Waste Disposal Records. The Contractor shall maintain records to document the quantity of waste generated; quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction activities, and a copy of the records shall be delivered to the Contracting Officer upon completion of the contract.
- 2.1.12. Final Cleaning. The Contractor shall remove all temporary structures, barricades, traffic control signs, and project signs following each debris removal and/or vegetation control activity.

2.1.13. Reporting and Geospatial Data Collection

- a. Reporting: GPS locations and field measurements of length for the base item and option items (if exercised) shall be provided to the COR at the time of the punch list walk through. Instruction for input of progress reporting and GPS data shall be collected and processed using Government provided procedures and a data dictionary. The web-base progress reporting system and data dictionary will contain the required fields specified and shall be provided by the Contracting Officer. Procedures for the input of progress data and GPS collection shall be provided to the contractor by the Contracting Officer prior to start of construction.
 - b. GPS Equipment: The Contractor shall provide required GPS equipment to the Contracting Officer's Representative for approval. The GPS equipment must contain a 416 MHZ. Intel X-Scale processor chip set. The equipment must be capable of recording 3-dimensional position (latitude, longitude, ortho height) of features and include numerous attributes as specified by the data dictionary. A copy of the feature, attribute, and data dictionary file will be supplied in digital (*.ddf format) and hard copy format prior to the initiation of construction, and instructions will be provided on their use.
 - i. The GPS equipment must be equivalent to a Trimble GeoXT or meet or exceed the below specifications:
 1. Microsoft Windows Mobile 5.x software
 2. Submeter accuracy in real-time
 3. Integrated SBAS
 4. RTCM real-time correction support
 5. NMEA and TSOP protocol support
 6. Multi-path rejection technology
 7. Temperature Operation range 14 degrees F to 122 degrees F
 8. Temperature Storage range -4 degrees F to 158 degrees F
 9. Casing of wind-driven and dust resistant per IP 54 standard
 10. Shock and vibration resistant
 11. GPS Channels 12 (L1 code and carrier)
 12. Update rates 1 Hz
 13. Protocols TSIP, NMEA (GGA, VTG, GLL, GSA, ZDA, GSV, RMC)
 14. Real-Time (SBAS or external RTCM source accuracy of submeter)
 - c. GPS Data Format: Data collection for GPS locations shall be in decimal degrees to nine decimal points, and be collected minimally at the start and end points of construction and shall include interim points as indicated by the collection procedures.
 - d. GPS Data Submittal: The contractor will download the GPS data collection files and prepare the digital files in ASCII comma delimited format, raw, GPS file (such as a .ssf from a Trimble unit), and ESRI Shape files based upon the structure of the supplied data dictionary. All data will be submitted to the COR the day of the punch list walk through. The intent of this submittal is to depict the completed construction in a GIS format. The proper attributes will be populated according to USACE SDSFIE standards. Metadata will be produced with each weekly update and submitted in either a *.txt or *.xml format.
 - e. GPS Data Final Submittal: Upon receipt of the GIS data submittal, the COR will have 14 calendar days to review and provide any comments to the Contractor. Upon receipt of comments, the Contractor shall complete the GPS Data file and submit with the as-built information.
- 2.1.14. Environmental Compliance. On 1 April 2008, the Secretary of the Department of Homeland Security signed an environmental waiver, supplied by Congress, to expedite the completion of the PF225 Border Fence Projects, which the original C-1 fence segment was a part. The waiver

extends to the Andrade Primary Fence Repair project as it is part of the C-1 fence segment. The Secretary's action waives local, state, and federal environmental regulatory compliance requirements. However, the Secretary has pledged to conduct environmental reviews of Projects including Andrade Primary Fence Repair and to also demonstrate environmental stewardship throughout project execution.

Specifically, the waiver allows for the completion of Andrade Primary Fence Repair project without completing the standard regulatory processes and securing permits for the laws listed in the waiver. Within this specifications document, this waiver shall be used to omit permitting/regulatory coordination that may fall under the environmental laws listed in the waiver. However, the Contractor shall adhere to and/or implement best management practices, mitigation measures, special conditions, environmental protection measures and all other activities related to environmental matters identified in this solicitation.

While modifications to the project as described in this solicitation are permitted by the waiver, an environmental review of any modifications to the project as described in this solicitation must be conducted prior to any construction related, ground disturbing activities. The Government will conduct the environmental review based on any modifications to the project, if proposed.

- 2.1.15. Environmental Assessment. An Environmental Assessment (EA) has been completed covering the limits of the original C-1 Border Fence Project. A copy of the EA can be provided upon request.
- 2.1.16. Storm Water Pollution Prevention Plan (SWPPP). Contractor shall be required to comply with the State of Arizona Construction General Permit and will be required to submit a Notice of Intent (NOI) Arizona Department of Environmental Quality (ADEQ). No physical work at the site shall begin prior to the Contractor receiving written approval of the project SWPPP. Contractor shall be required to comply with the SWPPP as a part of its execution of the project.

The COR reserves the right to require the Contractor to modify or revise the SWPPP to insure that all current measures to prevent offsite migration of pollutants, including soils, are included in the SWPPP, or if the Contracting Officer determines that the storm water pollution prevention requirements are not being met.

- 2.1.17. Best Management Practices. The Contractor shall implement all BMPs as outlined below. All BMPs shall be incorporated into the Contractor's Environmental Compliance Plan. As needed, environmental monitors, including cultural resource monitors and biological monitors, may be furnished by the Government at no cost to the Contractor to audit conformance with the BMPs during construction activities. The Contractor may be responsible for costs incurred to remediate or mitigate any environmental damage resulting from the contractor's failure to comply and implement these BMPs.

The following BMPs shall be implemented as standard operating procedures during all construction activities:

- 1) Best Management Practices (BMPs) shall be implemented as standard operating procedures during all construction activities. These BMPs shall include proper handling, storage, and/or disposal of hazardous and/or regulated materials. To minimize potential impacts from hazardous and regulated materials, all fuels, waste oils, and solvents will be collected and stored in tanks or drums within a secondary containment system that consists of an impervious floor and bermed sidewalls capable of containing the volume of the largest container stored therein. The refueling of machinery shall be completed following accepted guidelines, and all vehicles shall have drip pans during storage to contain minor spills and drips. Although it will be unlikely for a major spill to occur, any spill of 5 gallons or more shall be contained immediately within an earthen dike, and the application of an absorbent (e.g., granular, pillow, sock, etc.) shall be used to absorb and contain the spill. Furthermore, any spill of petroleum liquids (e.g., fuel) or material listed on 40 CFR 302 Table 302.4 of a

reportable quantity must be cleaned up and reported to the appropriate Federal and state agencies. Reportable quantities of those substances listed on 40 CFR 302 Table 302.4 will be included as part of the Spill Prevention, Control and Countermeasures Plan (SPCCP). A SPCCP will be in place prior to the start of construction and all personnel will be briefed on the implementation and responsibilities of this plan.

- 2) All waste oil and solvents shall be recycled. All non-recyclable hazardous and regulated wastes shall be collected, characterized, labeled, stored, transported, and disposed of in accordance with all Federal, state, and local regulations, including proper waste manifesting procedures.
- 3) Solid waste receptacles shall be maintained at staging areas. Non-hazardous solid waste (trash and waste construction materials) shall be collected and deposited in on-site receptacles. Solid waste shall be collected and disposed of by a local waste disposal contractor.
- 4) Waste materials and other discarded materials will be removed from the site as quickly as possible.
- 5) Waste water (water used for project purposes that is contaminated with construction materials, was used for cleaning equipment and thus carries oils or other toxic materials or other contaminants in accordance with state regulations) will be stored in closed containers on site until removed for disposal. Concrete wash water will not be dumped on the ground, but will be collected and moved offsite for disposal.
- 6) The perimeter of all areas to be disturbed during construction or maintenance activities shall be clearly demarcated using flagging or temporary construction fence, and no disturbance outside of that perimeter will be authorized.
- 7) No off-road vehicle activity will occur outside of the project footprint by the project proponent, project workers, and project contractors.
- 8) No pets owned or under the care of the project proponent or any and all construction workers will be permitted inside the project's construction boundaries, adjacent native habitats, or other associated work areas.
- 9) Vehicular traffic associated with the construction activities and operational support activities shall remain on established roads to the maximum extent practicable. Areas with highly erodible soils shall incorporate various BMPs, such as, straw bales, aggregate materials, and wetting compounds, to control erosion. A SWPPP will be prepared prior to construction activities and BMPs described in the SWPPP will be implemented to reduce erosion.
- 10) Any unnecessary ground disturbance, such as scraping or vegetation removal, shall be avoided within temporary staging areas as approved by the COR. When required, these areas shall be hand cleared to avoid disturbance to soils. Minimizing disturbance of the soils shall facilitate natural restoration (i.e., some native plants will resprout if not heavily disturbed), and shall impede the establishment of non-native plant species (i.e., many invasive, non-native plant species will easily invade and dominate heavily disturbed areas).
- 11) Construction equipment shall be cleaned using BMPs prior to entering and departing the project corridor to minimize the spread and establishment of non-native invasive plant species.
- 12) Transmission of disease vectors and invasive non-native aquatic species can occur if vehicles cross infected or infested streams or other waters and water or mud remains on the vehicle. If these vehicles subsequently cross or enter uninfected or infested waters, the disease or

invasive species may be introduced to the new area. To prevent this, crossing of streams or marsh areas with flowing or standing water will be avoided, and if not, the vehicle sprayed with a 10% bleach solution or allowed to dry completely to kill any organisms.

- 13) The U.S. Fish and Wildlife Service (USFWS) lists federally protected species with the potential of occurring in Imperial County. It is the Contractor's responsibility to be aware of these species and if any of these species are encountered the Contractor shall take appropriate measures to protect each species. Refer to the Environmental Assessment for a list of federally protected species.
- 14) The Government will designate a qualified biological monitor who will be responsible for overseeing compliance with protective measures for federally protected species during construction activities within designated areas. The designated biologist's qualifications will be subject to the approval of USFWS. The biologist will immediately notify the Government's designated representative to halt all associated project activities which may be in violation of the biological opinion. In such an event, the Government will halt all construction activities and contact USFWS within 24 hours. If an individual of a federally protected species is found in the designated project area, work will cease in the area of the species until either a qualified biological monitor can safely remove the individual, or it moves away on its own.
- 15) The biological monitor shall have the authority to temporarily suspend the project if necessary to ensure compliance with the BMPs. This authority must be provided to the biological monitor by the Contractor's construction manager in the worker orientation training.
- 16) Peninsular Bighorn Sheep. During any construction activities, if a sheep is seen within one mile of the activity, any work that could disturb the sheep will cease. For vehicle operations, this will entail stopping the vehicle until the sheep moves away. Vehicles may continue on at reduced speeds (10-15 miles per hour) once the sheep has moved away. For construction the biological monitor will request that work suspend until the sheep moves out of the area. If, after three hours of the initial sighting, sheep do not move beyond one mile away from the project activity or vehicle, project personnel will retreat from the area in the direction from which they came.
- 17) The Government has developed (in coordination with USFWS) a training plan regarding Trust Resources for border patrol and construction personnel that will be presented at the pre-construction meeting. At a minimum, the program will include the following topics: Occurrence of the listed and sensitive species in the area, their general ecology, sensitivity of the species to human activities, legal protection afforded these species, penalties for violations of Federal and State laws, reporting requirements, and project features designed to reduce the impacts to these species and promote continued successful occupation of the project area environs. Included in this program will be color photos of the listed species, which will be shown to the employees. Following the education program, the photos will be posted in the contractor and resident engineer office, where they will remain through the duration of the project. The Government and designated biological monitor will be responsible for ensuring that the Contractor's employees are aware of the listed species.
- 18) Water for construction use shall be from wells or irrigation water sources at the discretion of the landowner. If local groundwater pumping is an adverse effect to aquatic, marsh, or riparian dwelling federally protected species, treated water from outside the immediate area will be utilized.
- 19) The project site shall only be accessed using designated, existing roads. Parking will be in designated disturbed areas. This should limit the development of multiple trails to the project site and reduce the effects to federally protected species habitat in the vicinity.

- 20) There are no known sensitive cultural sites within the project corridor. If any cultural material is discovered during the construction efforts, then all activities will halt until a qualified archaeologist assesses the cultural remains. The Contractor may continue to work in areas that have been previously cleared, unless cultural resource materials are also discovered in these areas.
- 21) Standard construction procedures shall be implemented to minimize the potential for erosion and sedimentation during construction. All work shall cease during heavy rains, and shall not resume until conditions are suitable for the movement of equipment and materials.
- 22) All fuels, waste oils, and solvents shall be collected and stored in tanks or drums within a secondary containment area consisting of an impervious floor and bermed sidewalls capable of holding the volume of the largest container stored therein. The refueling of machinery shall be completed following accepted guidelines, and all vehicles shall have drip pans during storage to contain minor spills and drips. No refueling or storage shall take place within 100 feet of a drainage channel or structure. Other design measures shall be implemented, such as straw bales, silt fencing, aggregate materials, wetting compounds, and re-vegetation with native plant species, where possible, to decrease erosion and sedimentation. Furthermore, a SWPPP and all applicable Section 404/401 permit procedures shall be completed before construction shall be initiated within jurisdictional Waters of the U.S. (WUS). It shall be the responsibility of the Contractor to prepare and submit 404 and 401 permit applications to the respective USCOE and State offices.
- 23) All equipment maintenance, staging, laydown, and dispensing of fuel, oil, or any other such activities, will occur in designated upland areas. The designated upland areas will be located in such a manner as to prevent any runoff from entering waters of the United States, including wetlands.
- 24) If all ground disturbing activities cannot be completed outside of the migratory bird nesting season (February 1 - August 31), prior to the start of the project, and as a one time occurrence, the Government's biological monitor, at no cost to the contractor, shall conduct migratory bird surveys at the project site before said activities begin. Prior to the ground disturbing activities the Contractor shall provide the Government's resident engineer with a schedule for all ground disturbing activities such as geotechnical investigations, clearing and grubbing etc. which will be coordinated with the Government's biological monitor. The Government's biological monitor will locate and clearly mark bird nests 48 hours prior to the Contractor's scheduled ground disturbing activities. Under no circumstance shall the Contractor conduct any of the ground disturbing activities prior to the completion of the surveys by the Government's biological monitor. Clearing and grubbing and all other ground disturbing activities shall be limited to biologically surveyed areas.
- 25) To prevent entrapment of wildlife species during the construction of the project, all excavated, steep-walled holes or trenches more than 2 feet deep will either be covered at the close of each working day by plywood or provided with one or more escape ramps constructed of earth fill or wooden planks. The ramps will be located at no greater than 1,000-foot intervals and will be sloped less than 45 degrees. Each morning before the start of construction and before such holes or trenches are filled, they will be thoroughly inspected for trapped animals. Any animals so discovered will be allowed to escape voluntarily (by escape ramps or temporary structures), without harassment, before construction activities resume, or removed from the trench or hole by a qualified biologist and allowed to escape unimpeded.
- 26) To prevent entrapment of wildlife species during placement or vertical posts/bollards, all vertical fence posts/bollards that are hollow (i.e., those that will be filled with a reinforcing material such as concrete), shall be covered so as to prevent wildlife from entrapment. Covers will be deployed from the time the posts or hollow bollards are erected to the time they are filled with reinforcing material.

- 27) Mitigation measures will be incorporated to ensure that PM₁₀ emission levels do not rise above the de minimus threshold as required per 40 CFR 51.853(b)(1). Measures shall include dust suppression methods to minimize airborne particulate matter that will be created during construction activities. Standard construction BMPs, such as routine watering of the patrol, drag, and access roads, shall be used to control fugitive dust during the construction phases of the proposed project. Additionally, all construction equipment and vehicles shall be required to be kept in good operating condition to minimize exhaust emissions.
- 28) Construction speed limits will not exceed 35 miles per hour on major unpaved roads (graded with ditches on both sides) and 25 miles per hour on all other unpaved roads.
- 29) During the construction phase, short term noise impacts are anticipated. All Occupational Safety and Health Administration requirements shall be followed. Construction equipment shall possess properly working mufflers and shall be kept properly tuned to reduce backfires. Implementation of these measures shall reduce the expected short term noise impacts to an insignificant level in and around the construction site.
- 30) The Contractor shall take measures to ensure light plants or any type of lighting are not directed at areas of residence on either side of the International Boundary, in particular, the area of Los Algodones, Mexico.

APPENDIX A

CONSTRUCTION PLANS

DEPARTMENT OF HOMELAND SECURITY
CUSTOMS AND BORDER PROTECTION
OFFICE OF BORDER PATROL

YUMA SECTOR
ANDRADE PRIMARY FENCE REPAIR
DATE: OCTOBER 3, 2012



US Army Corps
of Engineers
Fort Worth District

90% SUBMITTAL
NOT FOR CONSTRUCTION

Baker
Michael Baker Jr., Inc.
2929 N. Central Avenue, Ste. 800
Phoenix, AZ 85012

ACI.....	American Concrete Institute
ADOT.....	Arizona Department of Transportation
ASTM.....	American Society for Testing Materials
APPROX...	Approximate
BF.....	Back Face
BM.....	Bench Mark
BOT.....	Bottom
BTWN.....	Between
CLR.....	Clear
CJ.....	Construction Joint
CONT.....	Continuation
CORT.....	Contracting Officer's Representative
CP.....	Control Point
CST.....	Construction
CL.....	Centerline
DIA.....	Diameter
D.....	Depth
DHS.....	Department of Homeland Security
DTLS.....	Details
E.....	Easting
EA.....	Each
EJ.....	Expansion Joint
Elev.....	Elevation
EPNG.....	El Paso Natural Gas
EQ.....	Equal
ETC.....	Etcetera
EX.....	Existing
FF.....	Front Face
FT.....	Feet/Foot
FND.....	Foundation
GA.....	Gauge
GALV.....	Galvanized
H.....	Height/High
HORZ.....	Horizontal
IN.....	Inches
INT.....	Intermediate
INFO.....	Information
LBS.....	Pounds
LWC.....	Low Water Crossing
L.P.....	Low Point
LT.....	Left
MEG.....	Match Existing Grade
MIN.....	Minimum
MAX.....	Maximum
MCAU.....	Manufactured Concrete Armor Unit
N.T.S.....	Not to Scale
N.....	Northing
N/A.....	Not Applicable
OC.....	On Center
P&P.....	Plan and Profile
PCC.....	Portland Cement Concrete
PF.....	Pedestrian Fence
PL.....	Plate
POE.....	Port of Entry
PSI.....	Pounds Per Square Inch
PTFE.....	Polytetrafluoroethylene
PVI.....	Point of Vertical Intersection
R.....	Radius
RD.....	Road
REINF.....	Reinforced
REQD.....	Required
RFP.....	Request for Proposal
ROW.....	Right Of Way
RVSS.....	Remote Video Surveillance System
SHT.....	Sheet
SWR.....	Sewer
STA.....	Station
SPECS.....	Specifications
TH.....	Thickness
TYP.....	Typical
TBD.....	To Be Determined
TRM.....	Turf Reinforcement Mat
UFGS.....	Unified Facilities Guide Specifications
UG.....	Underground
UNO.....	Unless Noted Otherwise
USACE.....	United States Army Corps Of Engineers
USIBWC.....	United States International Boundary & Water Commission
VERT.....	Vertical
VF.....	Vehicular Fence
W/.....	With
WSE.....	Water Surface Elevation
WTR.....	Water Main
&.....	and

Base Course	
Prepared Subgrade	
Aggregate Surface/ Native Soil	
Engineered Fill	
New Conc.	
New Rip Rap	
Center Line	
Geometry Table Reference Number	
Border Monument	
Existing Light Pole	
Flow Arrow	
Permanent Easement	
Existing Fence	
New Fence	
Cut Line	
Fill Line	
Straw Rolls	
Silt Fence	
Drilled Shaft Wall	
Modular Block Retaining Wall	

<u>DESCRIPTION</u>	<u>SHEET NO.</u>
COVER	
ABBREVIATIONS, LEGEND, AND SHEET INDEX	G-1.01
GENERAL NOTES	G-1.02
GENERAL NOTES	G-1.03
KEY MAP & GEOMETRIC CONTROL DATA	C-1.01
PLAN VIEW C-1 FENCE ALIGNMENT	C-2.01
CROSS SECTIONS	C-3.01
CROSS SECTIONS	C-3.02
CROSS SECTIONS	C-3.03
CROSS SECTIONS	C-3.04
AREA 2 GRADING PLAN	D-1.01
RETAINING WALL ELEVATIONS	S-1.01
RETAINING WALL CROSS SECTIONS	S-1.02
DETAILS	S-1.03
BOLLARD FENCE WITH PLATE SHEET 1 OF 2	S-1.04
BOLLARD FENCE WITH PLATE SHEET 2 OF 2	S-1.05

1. ANY AND ALL DAMAGES TO EXISTING ROADS, FENCE, UTILITIES, AND ALL OTHER EXISTING STRUCTURES RESULTING FROM THE CONTRACTOR'S CONSTRUCTION ACTIVITIES SHALL BE REPLACED AND REPAIRED TO ORIGINAL CONDITION OR BETTER, AND TO THE SATISFACTION OF THE COR (CONTRACTING OFFICERS REPRESENTATIVE) AT THE EXPENSE OF THE CONTRACTOR.
2. THE CONTRACTOR, AT HIS OWN EXPENSE SHALL RESPOND TO COMPLAINTS REGARDING DUST AND NOISE POLLUTION RESULTING FROM HIS WORK.
3. THE CONTRACTOR SHALL PROVIDE SAFE ACCESS TO AND FROM ALL DRIVEWAYS AND STREETS, PAVED OR UNPAVED, AT ALL TIMES DURING CONSTRUCTION.
4. THE CONTRACTOR SHALL VERIFY AND CHECK ALL DIMENSIONS, LOCATIONS, ELEVATIONS, AND DETAILS SHOWN ON THESE DRAWINGS PRIOR TO THE START OF CONSTRUCTION. ANY UNCERTAINTIES AND DISCREPANCIES SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE CONTRACTING OFFICER FOR CLARIFICATION PRIOR TO COMMENCING THAT WORK FEATURE.
5. THE PROJECT SHALL BE SECURED AT ALL TIMES DURING CONSTRUCTION.
6. THE CONTRACTOR SHALL DISPOSE OF ALL CONSTRUCTION DEBRIS AND OTHER WASTE MATERIAL OFF THE GOVERNMENT OWNED LAND AT AN APPROVED OFF-SITE DISPOSAL AREA IN ACCORDANCE WITH APPLICABLE REGULATORY AGENCY REQUIREMENTS. ALL PERMITS REQUIRED FOR OFF-SITE DISPOSAL SHALL BE OBTAINED BY THE CONTRACTOR.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COMPLIANCE WITH AND THE ENFORCEMENT OF ALL APPLICABLE SAFETY REGULATIONS.
8. IN CASE OF DISCREPANCY BETWEEN THE SPECIFICATIONS AND CONSTRUCTION DOCUMENTS, THE MORE STRINGENT SHALL APPLY.
9. ALL WORK SHALL BE COMPLETED TO THE SATISFACTION OF USACE, DHS, AND USBWC.
10. CONTRACTOR SHALL CONFINE ALL WORK EFFORTS WITHIN THE DESIGNATED R.O.W. OR EASEMENTS UNLESS SPECIFICALLY AUTHORIZED IN WRITING TO DO OTHERWISE BY THE OWNER OR THE OWNER'S AUTHORIZED REPRESENTATIVE.
11. THE CONTRACTOR SHALL PRESERVE AND PROTECT OR REMOVE AND REPLACE (WITH PRIOR WRITTEN APPROVAL OF AFFECTED PROPERTY OWNERS) ALL TREES, SHRUBS, HEDGES, RETAINING WALLS, LANDSCAPING, BUILDINGS, WALKS, ETC., IN OR NEAR CONSTRUCTION AREA.

1. LOCATIONS OF UNDERGROUND UTILITIES ARE FROM BEST INFORMATION AVAILABLE AT THE TIME THESE PLANS WERE PREPARED. THE GOVERNMENT DOES NOT WARRANT THE ACCURACY OF THE INFORMATION PROVIDED. ANY DEVIATION SHALL BE CALLED TO THE ATTENTION OF THE COR PRIOR TO PROCEEDING WITH WORK IN THE AREA OF FOUND UTILITIES.
2. PUBLIC AND PRIVATE UTILITY LINES AND CUSTOMER SERVICE LINES MAY EXIST THAT ARE NOT SHOWN ON THE CONSTRUCTION DRAWINGS. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO LOCATE, MAINTAIN AND PROTECT THE INTEGRITY OF THESE LINES. HAND EXCAVATION MAY BE REQUIRED.
3. CONTRACTOR SHALL COORDINATE WITH THE APPROPRIATE UTILITY COMPANY TO RELOCATE OR DIVERT ANY UTILITY IN CONFLICT WITH PROPOSED CONSTRUCTION SO AS NOT TO DISRUPT SERVICE OF IT. CONTRACTOR SHALL RESTORE, RELOCATE OR DIVERT UTILITY TO ITS ORIGINAL CONDITION AND LOCATION WHEN APPLICABLE UPON COMPLETION OF CONSTRUCTION.

1. EGRESS/INGRESS TO THE PROJECT SITE SHALL BE FROM THE EXISTING ROADS SHOWN IN THE PLANS. THE CONTRACTOR SHALL NOT USE ANY OTHER ROADS FOR ACCESS TO OR ON THE SITE.
2. EGRESS/INGRESS AND HAUL ROUTES MAY BE USED BY MORE THAN ONE CONTRACTOR. COOPERATION BETWEEN CONTRACTORS IS EXPECTED AS CONTRACTORS USING THE ROUTES SHALL WORK OUT A ROAD MAINTENANCE SCHEDULE IN ORDER TO KEEP AT ALL TIMES DRIVABLE AND WORKABLE CONDITIONS.
3. ALL ACCESS ROADS AND STAGING AREAS SHALL BE RETURNED TO EQUAL OR BETTER CONDITIONS UPON COMPLETION OF CONSTRUCTION. SEE SECTION 01 00 50 FOR ADDITIONAL INFORMATION AND REQUIREMENTS.

1. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ADEQUATE DRAINAGE AT ALL TIMES DURING CONSTRUCTION OF PROPOSED FACILITIES.
2. CONTRACTOR SHALL PROVIDE POSITIVE DRAINAGE AT ALL TIMES DURING THE INSTALLATION OF THE STRUCTURES AND DRAINAGE IMPROVEMENTS.

1. CONTRACTOR SHALL PROVIDE AND MAINTAIN SEDIMENT CONTROL SERVICES IN ACCORDANCE WITH THE CONTRACT DOCUMENTS THROUGHOUT THE TERM OF THE WORK COVERED BY THIS CONTRACT.

1. PRIOR TO GENERAL GRADING, ALL AREAS TO BE IMPROVED SHOULD BE STRIPPED OF ANY EXISTING STRUCTURES AND VEGETATION. ALL DEBRIS OR OTHER DELETERIOUS MATERIALS SHOULD BE EXCAVATED AND DISPOSED AT AN APPROVED OFF-SITE DISPOSAL AREA IN ACCORDANCE WITH APPLICABLE REGULATORY AGENCY REQUIREMENTS. ALL PERMITS REQUIRED FOR OFF-SITE DISPOSAL SHALL BE OBTAINED BY THE CONTRACTOR. SEE SPEC SECTION 31 11 00 FOR ADDITIONAL INFORMATION.
2. ALL UNSUITABLE SOILS AND UNCONTROLLED FILLS (IF APPLICABLE) SHOULD BE REMOVED AND REPLACED WITH ENGINEERED FILL. REMOVED MATERIAL MAY BE USED AS ENGINEERED FILL PROVIDED IT MEETS THE REQUIREMENTS FROM ENGINEERED FILL SECTION.
3. ALL AREAS TO RECEIVE ENGINEERED FILL FOR THE FUTURE SUPPORT SHALL BE SCARIFIED TO A DEPTH OF 8", UNIFORMLY MOISTURE-CONDITIONED TO WITHIN 3% OF THE OPTIMUM MOISTURE CONTENT, AND COMPACTED TO AT LEAST 90% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM TEST METHOD D1557.
4. GRADING PERFORMED DURING OR SUBSEQUENT TO WET WEATHER MAY RESULT IN NEAR-SURFACE SITE SOILS WITH MOISTURE CONTENTS SIGNIFICANTLY ABOVE OPTIMUM. THIS CONDITION COULD HAMPER EQUIPMENT MANEUVERABILITY AND EFFORTS TO COMPACT SITE SOILS TO THE RECOMMENDED COMPACTION CRITERIA. DURING MOST OF THE YEAR, THE SITE WILL TYPICALLY DRY TO WORKABLE MOISTURE CONTENTS WITHIN ONE TO TWO DAYS. IF TIME IS A CRITICAL FACTOR, DISKING FOR AERATION, CHEMICAL TREATMENT, REPLACEMENT WITH DRIER MATERIAL, STABILIZATION WITH A GEOTEXTILE FABRIC OR GRID, OR OTHER METHODS MAY BE IMPLEMENTED TO REDUCE EXCESSIVE SOIL MOISTURE AND FACILITATE EARTHWORK OPERATIONS.

1. ALL EXCAVATED MATERIAL IS TO BE REMOVED FROM THE PROJECT AND STAGING AREAS AND DISPOSED OF AT AN APPROVED OFF-SITE LOCATION, UNLESS OTHERWISE NOTED OR APPROVED FOR USE AS BACKFILL MATERIAL.
2. TRUCKS SHALL BE LOADED IN A MANNER SO AS TO AVOID LOSS OF LOADED MATERIAL OR ANY PORTION THEREOF DURING TRANSPORT IN ACCORDANCE WITH STATE LAW. ALL TRUCKS SHALL UTILIZE TARPS.
3. THE CONTRACTOR SHALL BE RESPONSIBLE TO REPAIR ANY HAUL ROAD SURFACE IRREGULARITIES, AS DIRECTED BY THE COR, CAUSED BY THE CONTRACTOR'S LOADING OR HAULING OPERATIONS.
4. SEE SPECIFICATION SECTION 31 00 00 FOR ADDITIONAL INFORMATION.

1. ENGINEERED FILL REQUIRED TO BRING THE SITE TO GRADE SHOULD BE FREE OF VEGETATION AND DEBRIS, AND CONTAIN NO ROCKS OR LUMPS LARGER THAN 3" NOMINAL DIAMETER. ENGINEERED FILL SHOULD MEET THE FOLLOWING GRADATION REQUIREMENTS WHEN TESTED IN ACCORDANCE WITH ASTM TEST METHOD C 136:

SCREEN SIZE (SQUARE OPENING)	PERCENT PASSING BY WEIGHT
3"	100
NO. 4	40-100
NO. 200	2-50

THE SOILS SHOULD POSSESS A PLASTICITY INDEX OF NO GREATER THAN 15 AND A LIQUID LIMIT NO GREATER THAN 35 WHEN TESTED IN ACCORDANCE WITH ASTM TEST METHOD D 4318.

2. ENGINEERED FILL SHOULD BE UNIFORMLY MOISTURE-CONDITIONED TO WITHIN 3% OF THE OPTIMUM MOISTURE CONTENT, PLACED IN HORIZONTAL LIFTS NO GREATER THAN 8" IN LOOSE THICKNESS, AND COMPACTED BY MECHANICAL MEANS ONLY, TO AT LEAST 90% OF THE MAXIMUM DRY DENSITY. OPTIMUM MOISTURE CONTENT AND MAXIMUM DENSITY SHOULD BE DETERMINED IN ACCORDANCE WITH ASTM TEST METHOD D1557.

3. EXCAVATED ON-SITE SOILS MEETING THE ABOVE REQUIREMENT MAY BE REUSED FOR ENGINEERED FILL. IMPORTED MATERIALS SHOULD MEET THE PREVIOUSLY PRESENTED REQUIREMENTS FOR ENGINEERED FILL AND SHOULD BE INSPECTED AND TESTED AT THE SOURCE PRIOR TO IMPORTATION TO THE SITE.

1. DUE TO VARIABILITY OF SITE SOILS, ISOLATED AREAS OF THE SUBGRADE MAY REQUIRE OVER-EXCAVATION AND RECOMPACTION TO MITIGATE LOOSE OR DISTURBED SOIL CONDITIONS. SUBGRADE SHALL BE PROOF-ROLLED WITH A LOADED 10,000-GALLON WATER TRUCK FOLLOWING CLEARING, GRUBBING, AND SITE GRADING. AREAS OBSERVED TO DEFLECT UNDER THE PRESSURE EXERTED BY THE 10,000-GALLON WATER TRUCK WILL REQUIRE OVER-EXCAVATION AND REPLACEMENT WITH ENGINEERED FILL. OVER-EXCAVATION AND REPLACEMENT SHALL BE LIMITED TO A DEPTH OF 1'.
2. SUBGRADE SOILS SHOULD BE UNIFORMLY MOISTURE-CONDITIONED TO WITHIN 3% OF THE OPTIMUM MOISTURE CONTENT, AND COMPACTED TO AT LEAST 90% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM TEST METHOD D1557.
3. SEE SPECIFICATION SECTION 31 00 00 FOR ADDITIONAL INFORMATION.

FIELD QUALITY CONTROL
1. TESTING AGENCY: CONTRACTOR WILL ENGAGE A QUALIFIED INDEPENDENT GEOTECHNICAL ENGINEERING TESTING AGENCY TO PERFORM FIELD QUALITY CONTROL TESTING. CONTRACTOR WILL COORDINATE TESTING WITH OWNER AND SELECTED GEOTECHNICAL FIRM. CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING OWNER WHEN TESTING WILL BE REQUIRED. A MINIMUM OF 24-HOURS ADVANCE NOTICE IS REQUIRED.

2. ALLOW TESTING AGENCY TO INSPECT AND TEST SUBGRADES AND EACH FILL OR BACKFILL LAYER, PROCEED WITH SUBSEQUENT EARTHWORK ONLY AFTER TEST RESULTS FOR PREVIOUSLY COMPLETED WORK COMPLY WITH REQUIREMENTS.

3. A GEOTECHNICAL ENGINEER OR A QUALIFIED INSPECTOR SHALL REVIEW CONDITIONS OF NATIVE SOILS EXPOSED IN FOUNDATION EXCAVATIONS FOR CONSISTENCY WITH THE SOIL CONDITIONS ANTICIPATED BY THE PROJECT GEOTECHNICAL REPORT AND FOR APPLICABILITY OF THE RECOMMENDATIONS FOR BEARING ON NATIVE SOILS PRESENTED IN THE PROJECT GEOTECHNICAL REPORT, IF SOIL CONDITIONS SIGNIFICANTLY DIFFERENT THAN THOSE ENCOUNTERED IN THE BORINGS FOR THE PROJECT GEOTECHNICAL REPORT ARE OBSERVED DURING REVIEW OF NATIVE SOILS IN FOUNDATION AREAS. A GEOTECHNICAL ENGINEER MUST REVIEW THE ENCOUNTERED CONDITIONS AND DEVELOP RECOMMENDATIONS FOR ADDITIONAL EXPLORATION AND REVISE RECOMMENDATIONS IN THE GEOTECHNICAL REPORT AS NEEDED BASED ON THE RESULTS OF ADDITIONAL EXPLORATION.

4. TESTING AGENCY WILL TEST COMPACTION OF SOILS IN PLACE ACCORDING TO ASTM D 1556, ASTM D 2167, ASTM D 2922, AND ASTM D 2937, AS APPLICABLE. TESTS WILL BE PERFORMED AT THE FOLLOWING LOCATIONS AND FREQUENCIES.

5. TRENCH BACKFILL: AT EACH COMPACTED INITIAL AND FINAL BACKFILL LAYER, AT LEAST ONE TEST FOR EACH 150 FEET (46M) OR LESS OF TRENCH LENGTH, BUT NO FEWER THAN TWO TESTS.

6. WHEN TESTING AGENCY REPORTS THAT SUBGRADES, FILLS, OR BACKFILLS HAVE NOT ACHIEVED DEGREE OF COMPACTION SPECIFIED, SCARIFY AND MOISTEN OR AERATE, OR REMOVE AND REPLACE SOIL TO DEPTH REQUIRED, RECOMPACT AND RETEST UNTIL SPECIFIED COMPACTION IS OBTAINED.

7. CONCRETE PLACEMENT IS TO BE OBSERVED BY THE ENGINEER'S REPRESENTATIVE TO ENSURE THAT IT MEETS REQUIREMENTS. A QUALITY CONTROL REPORT, DOCUMENTING COMPLIANCE WITH DESIGN DETAILS AND SPECIFICATIONS, IS TO BE SUBMITTED FOR EACH DRILLED SHAFT.

(b) (7)(E)

(b) (7)(E)

5. FIELD WELDING, CUTTING OR BENDING OF REINFORCEMENT SHALL NOT BE ALLOWED UNLESS NOTED OTHERWISE OR UNLESS PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER.

6. LAP BARS ONLY AT LOCATIONS SHOWN ON THE DRAWINGS, OR AS APPROVED BY THE CORPS.

[illegible]

90% SUBMITTAL
NOT FOR
CONSTRUCTION

Baker
Michael Baker Jr., Inc.
2219 N. Central Avenue, Suite 400
Phoenix, AZ 85012

W.L.C.	10/3/12
Down by: (b) (6)	Submitted by:
Reviewed by: (b) (6)	Plot date: 10/3/12

CUSTOMS AND BORDER PROTECTION
OFFICE OF BORDER PATROL
YUMA SECTION

GENERAL NOTES

G-1.02

STRUCTURAL STEEL:

1. STRUCTURAL STEEL SHALL CONFORM TO SPECIFICATION SECTION 05 12 00.
2. AS APPLICABLE, STRUCTURAL STEEL SHOP DRAWINGS, INCLUDING THE DESIGN AND DETAILING OF STRUCTURAL STEEL CONNECTIONS SHALL BE DONE UNDER THE SUPERVISION OF A LICENSED PROFESSIONAL ENGINEER.
3. E70XX ELECTRODES SHALL BE USED FOR ALL WELDING.

RETAINING WALL FOUNDATIONS:

1. FOUNDATIONS SHALL BE CAST ON PROPERLY COMPACTED SOIL. NATIVE SOILS SHALL BE COMPACTED TO AT LEAST 95% RELATIVE DENSITY AT +2% OF OPTIMUM MOISTURE. (ASTM D1557).
2. SEE SHEET S-1.03 FOR DRILLED SHAFT REQUIREMENTS.

SITE CLEAN-UP:

1. THE CONTRACTOR SHALL CLEANUP AND RESTORE THE AREA OF OPERATIONS TO A CONDITION AS GOOD AS OR BETTER THAN THAT WHICH EXISTED PRIOR TO INSTALLATION OF ALL ITEMS TO BE CONSTRUCTED.
2. THE CONTRACTOR SHALL REMOVE FROM THE PROJECT AREA ALL SURPLUS MATERIAL. THIS SHALL BE INCIDENTAL AND NOT A SEPARATE PAY ITEM UNLESS STATED OTHERWISE. SURPLUS MATERIALS FROM EXCAVATION INCLUDING SPOILS, CONCRETE, TRASH, ETC., SHALL BE PROPERLY DISPOSED OF AT A SITE ACCEPTABLE TO USACE. THE CONTRACTOR SHALL PROVIDE A LETTER STATING SO. NO EXCESS EXCAVATED MATERIAL SHALL BE DEPOSITED IN LOW AREAS OR ALONG NATURAL DRAINAGE WAYS WITHOUT WRITTEN PERMISSION FROM THE AFFECTED PROPERTY OWNERS AND THE USACE. IF THE CONTRACTOR PLACES EXCESS MATERIAL IN THE AREAS WITHOUT WRITTEN PERMISSION, HE WILL BE RESPONSIBLE FOR ALL DAMAGE RESULTING FROM SUCH FILL AND CONTRACTOR SHALL REMOVE THE MATERIAL AT OWN COST.
3. CONTRACTOR TO ENSURE THAT ALL EXCAVATION MATERIALS STAY WITHIN THE U.S. BOUNDARY.

BASE CONTRACT AND OPTIONS:

CONSTRUCTION WORK IS SPLIT INTO A BASE CONTRACT WITH 2 OPTIONS.

BASE CONTRACT: (b) (7)(E)

OPTION 1 (b) (7)(E)
OPTION 2 (b) (7)(E)

[illegible]

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Baker
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2529 N. Central Avenue, Suite 400
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OWN BY: [REDACTED] (b) (6)	W.L.C.	10/31/12
REVIEWED BY: [REDACTED] (b) (6)	Submitted by:	
Plot date:		10/31/12

GENERAL NOTES

G-1.03



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Phoenix, AZ 85013

OWN DTC:	CLD DTC:	W.L.C.	10/3/12
		Submitted by:	
		(b) (6)	
Reviewed by:		Plot date:	
(b) (6)		10/3/12	

KEY MAP & GEOMETRIC CONTROL DATA

C-1.01

C-1 FENCE REPAIR CONSTRUCTION CENTERLINE					
POINT DESCRIPTION	STATION	BEARING	DISTANCE	NORTHING	EASTING
POB	(b) (7)(E)				
PI					
POE					

SITE BENCH MARKS				
POINT #	NORTHING	EASTING	DESCRIPTION	ELEVATION
101				
102				

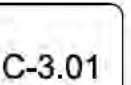
(b) (7)(E)

(b) (7)(E) STATION DESCRIBED AS A [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
(b) (7)(E) STATION DESCRIBED AS A [REDACTED] (b) (7)(E)
[REDACTED]
(b) (7)(E)

THE CONTRACTOR SHALL BE RESPONSIBLE FOR RE-SETTING ANY BENCHMARKS FOUND WITHIN THE CONSTRUCTION FOOT PRINT. THIS WORK SHALL BE DONE UNDER THE DIRECTION OF A PROFESSIONAL LAND SURVEYOR AND THE INFORMATION SHALL BE PROVIDED TO THE GOVERNMENT FOR THEIR RECORDS.

(b) (7)(E)

(b) (7)(E)



(b) (7)(E)

C-3.02

(b) (7)(E)



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Fort Worth District

[illegible]

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Phoenix, AZ 85012

DEPARTMENT OF HOMELAND SECURITY CUSTOMS AND BORDER PROTECTION OFFICE OF TRADE AND TRADE TAMA SECTOR	Designed by:	Dates:	Rev.
	W.L.C.	10/9/12	
	Own Use	Subscribed by:	
	(b) (6)		
	Reviewed by:	Plot date:	
		10/9/12	
		(b) (6)	

ANDRADE FENCE REPAIR

CROSS SECTIONS

STA [REDACTED] (b) (7)(E)

C-3.03

(b) (7)(E)

(b) (7)(E)

BW23 FOIA CBP 004503



US Army Corps
of Engineers
Fort Worth District

[illegible]

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8200 W. Camel Avenue, Suite 600
Phoenix, AZ 85012

DEPARTMENT OF HOMELAND SECURITY CUSTOMS AND BORDER PROTECTION APPROPRIATE WORK AREA YUMA SECTION	Assigned by:	W.L.C.	Rev.
	Drawn by:	10/31/12	
	Class by:		Submitted by:
	Reviewed by:		Plat date:
		10/31/12	

ANDRADE FENCE REPAIR
CROSS SECTION
STA [REDACTED] (7) X E

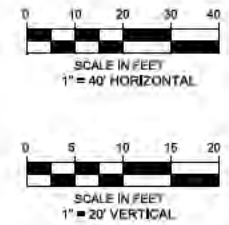
C-3.04

(b) (7)(E)



D-1.01

(b) (7)(E)



US Army Corps of Engineers Fort Worth District		Date: _____ Sheet: _____	
90% SUBMITTAL NOT FOR CONSTRUCTION		Baker Michael Baker Jr., Inc. 2000 West 10th Street, Suite 400 Ft. Worth, TX 76102	
Designed by: W.L.C.	Date: 10/3/12	Submitted by: [Redacted]	Rev: _____
Drawn by: [Redacted]	Checked by: [Redacted]	Plot date: 10/3/12	
DEPARTMENT OF HOMELAND SECURITY CUSTOMS AND BORDER PROTECTION YUMA SECTION			
ANDRADE FENCE REPAIR RETAINING WALL ELEVATIONS			
S-1.01			

(b) (7)(E)

(b) (7)(E)

[illegible]

54% SUBMITTAL
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CONSTRUCTION

Baker
Michael Baker Jr., Inc.
2829 N. Central Avenue, Suite 400
Phoenix, AZ 85015

CASE NO.	W.L.C.	10/31/12
DATE FOR OFFICE OF BORDER PATROL YUMA REGION	OWN BY:	SUBMITTED BY:
	(b) (6)	(b) (6)
	DATE:	10/31/12
	(b) (6)	(b) (6)

RETAINING WALL DETAILS

SHEET
S-1.03

(b) (7)(E)

(b) (7)(E)

NOTES:

1. INTERMEDIATE PANEL BOLLARDS SHALL BE IN A NEAT & ORDERLY ACROSS THE PANEL. THE TOPS OF INTERMEDIATE PANEL BOLLARDS SHALL BE INSTALLED (b) (7)(E) OF THE STEEL SHEATHING. CUTTING OF INTERMEDIATE PANEL BOLLARDS NOT REQUIRED.

S-1.04

**BOLLARD FENCE
WITH PLATE
SHEET 1 OF 2**

CUSTOMS AND BORDER PROTECTION
OFFICE OF BORDER PATROL
YUMA SECTION

OWN by: Ckd by:

10/3/12
Submitted

1

Baker

Baker
Michael Baker Jr., Inc.
2229 N. Central Avenue, Suite 800
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US Army Corps
of Engineers
Fort Worth District

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BW23 FOIA CBP 004508

(b) (7)(E)

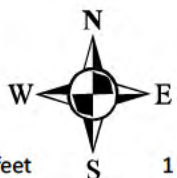
APPENDIX B

ACCESS & STAGING MAP

C-1 Fence Repair Project - Access Road and Site Locations



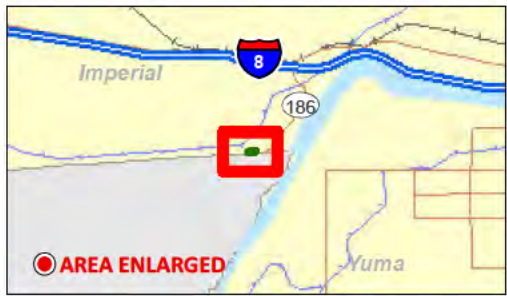
LEGEND



1 inch = 450 feet 1 inch = 0.09 miles

Legend

- Area 1 (Option 2)
- Area 2 (Base)
- Area 3 (Option 1)
- State Route 186
- Project Access
- Staging Area



Date: 10/3/2012 Baker
Michael Baker Jr., Inc.

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APPENDIX C

CONSTRUCTION SPECIFICATIONS

**ANDRADE PRIMARY FENCE REPAIR
CONSTRUCTION SPECIFICATIONS – 90% SUBMITTAL**

OFFICE OF BORDER PATROL, YUMA SECTOR

**CUSTOMS AND BORDER PROTECTION
DEPARTMENT OF HOMELAND SECURITY**

IMPERIAL COUNTY, CALIFORNIA

SECTION	DESCRIPTION
03 20 00.00 10	Concrete Reinforcing
03 30 00.00 10	Cast-in-Place Concrete
03 37 13	Shotcrete
03 60 00	Grouting
	Soil Cement
05 05 23	Welding, Structural
05 12 00	Structural Steel
31 00 00	Earthwork
31 63 29	Drilled Concrete Piers and Shafts
	Pre-Manufactured Retaining Wall System

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SECTION 03 20 00.00 10

CONCRETE REINFORCING
08/10

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318 (2011) Building Code Requirements for
Structural Concrete and Commentary

ACI SP-66 (2004) ACI Detailing Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M (2011) Structural Welding Code -
Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1035/A1035M (2009) Standard Specification for
Deformed and Plain, Low-carbon, Chromium,
Steel Bars for Concrete Reinforcement

ASTM A184/A184M (2006e1) Standard Specification for
Fabricated Deformed Steel Bar Mats for
Concrete Reinforcement

ASTM A370 (2011) Standard Test Methods and
Definitions for Mechanical Testing of
Steel Products

ASTM A497/A497M (2007) Standard Specification for Steel
Welded Wire Reinforcement, Deformed, for
Concrete

ASTM A53/A53M (2010) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A615/A615M (2009b) Standard Specification for
Deformed and Plain Carbon-Steel Bars for
Concrete Reinforcement

ASTM A675/A675M (2003; R 2009) Standard Specification for
Steel Bars, Carbon, Hot-Wrought, Special
Quality, Mechanical Properties

ASTM A706/A706M (2009b) Standard Specification for
Low-Alloy Steel Deformed and Plain Bars

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	for Concrete Reinforcement
ASTM A767/A767M	(2009) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A884/A884M	(2006) Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934/A934M	(2007) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM E 94	(2004; R 2010) Radiographic Examination
CONCRETE REINFORCING STEEL INSTITUTE (CRSI)	
CRSI 10MSP	(2009; 28th Ed) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding
Butt-Splices; G
Material; G

SD-04 Samples

Epoxy-Coated Bars

SD-06 Test Reports

Material; G
Tests, Inspections, and Verifications; G

SD-07 Certificates

Reinforcing Steel
Qualification of Steel Bar Butt-Splicers

1.3 QUALITY ASSURANCE

1.3.1 Welding Qualifications

Welders shall be qualified in accordance with AWS D1.4/D1.4M.

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Qualification test shall be performed at the worksite and notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4/D1.4M. Submit a list of qualified welders names.

1.3.2 Qualification of Steel Bar Butt-Splacers

Qualification of steel bar butt-splacers shall be certified to have satisfactorily completed a course of instruction in the proposed method of butt-splicing or have satisfactorily performed such work within the preceding year. Submit certificates on the Qualifications of Steel Bar Butt-Splacers prior to commencing butt-splicing.

1.3.3 Qualification of Butt-Splicing Procedure

As a condition of approval of the butt-splicing procedure, make three test butt-splices of steel bars of each size to be spliced using the proposed butt-splicing method, in the presence of the Contracting Officer. These test butt-splices and unspliced bars of the same size shall be tension tested to destruction with stress-strain curves plotted for each test. Test results shall show that the butt-splices meet the specified strength and deformation requirements in order for the splicing procedure to be approved.

1.4 DELIVERY, STORAGE, AND HANDLING

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A675/A675M, Grade 80. Steel pipe conforming to ASTM A53/A53M, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A184/A184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A615/A615M, ASTM A706/A706M, or ASTM A1035/A1035M grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A82/A82M. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A767/A767M, ASTM A775/A775M, ASTM A1035/A1035M or ASTM A934/A934M as appropriate.

Submit certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

2.3.1 Epoxy-Coated Bars

Epoxy-coated steel bars shall comply with the requirements of ASTM A775/A775M, including written certifications for coating material and

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coated bars, sample of coating material, and 1.5 pounds of patching material.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A497/A497M. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A884/A884M. For wire with a specified yield strength (fy) exceeding 60,000 psi, fy shall be the stress corresponding to a strain of 0.35 percent.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

Bar supports shall comply with the requirements of ACI SP-66. Supports for bars in concrete with formed surfaces exposed to view or to be painted shall be plastic-coated wire, stainless steel or precast concrete supports. Precast concrete supports shall be wedged-shaped, not larger than 3-1/2 by 3-1/2 inches, of thickness equal to that indicated for concrete cover and have an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view shall be the same quality, texture and color as the finish surfaces.

2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests, specified and required by applicable standards, by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests, inspections, and verifications shall be performed and certified at the Contractor's expense. Submit certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications for each steel shipment and identified with specific lots prior to placement. Submit three copies of the heat analyses for each lot of steel furnished certifying that the steel conforms to the heat analyses.

2.7.1 Reinforcement Steel Tests

Mechanical testing of steel shall be in accordance with ASTM A370 except as otherwise specified or required by the material specifications. Tension tests shall be performed on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. Chemical analyses of steel heats shall show the percentages of

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carbon, phosphorous, manganese, sulphur and silicon present in the steel.

2.7.2 Radiographic Examination of Welds

Radiographic examination of welds shall be in accordance with ASTM E 94 and shall be performed and evaluated by an approved testing agency adequately equipped to perform such services. Radiographs of welds and evaluations of the radiographs submitted for approval shall become the property of the Government.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement steel and accessories shall be fabricated and placed as specified and shown and approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI SP-66 and ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Epoxy-coated bars shall be mill-bent prior to coating. All steel shall be bent cold unless authorized. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms. Submit detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4/D1.4M. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

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3.1.3 Placing Tolerances

3.1.3.1 Spacing

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 1 inch.

3.1.3.2 Concrete Cover

The minimum concrete cover of main reinforcement steel bars shall be as shown. The allowable variation for minimum cover shall be as follows:

MINIMUM COVER (inch)	VARIATION (inch)
6	plus 1/2
4	plus 3/8
3	plus 3/8
2	plus 1/4
1-1/2	plus 1/4
1	plus 1/8
3/4	plus 1/8

3.1.4 Splicing

Splices in steel bars shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Government subject to approval.

3.1.4.1 Lap Splices

Lap splices shall be used only for bars smaller than size 14 and welded wire fabric. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than 1/5 the required length of lap or 6 inches.

3.1.4.2 Butt-Splices

Use butt-splices only for splicing size 14 and 18 bars and for splicing #11 bars to larger bars except where otherwise shown or authorized. Make butt-splices by a method which develops splices suitable for tension, compression and stress reversal applications. Welded butt-splices shall be full penetration butt welds. Butt-splices shall develop 90 percent of the specified minimum ultimate tensile strength of the smallest bar of each splice. Bars shall be cleaned of all oil, grease, dirt, rust, scale and other foreign substances and shall be flame dried before splicing. Adequate jigs and clamps or other devices shall be provided to support, align and hold the longitudinal centerline of the bars to be butt-spliced

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in a straight line. Submit proposed procedure for butt-splicing steel bars prior to making the test butt-splices for qualification of the procedure. Properties and analyses of steel bars and splicing materials shall be included in the submitted procedure. Physical properties of splicing sleeves shall include length, inside and outside diameters, and inside surface details.. Butt-splices shall be as follows:

a. Thermit Welded Butt Splices - Bars to be thermit welded shall be restricted to steel shown by heat analysis to have a sulfur content not exceeding 0.05 percent. The ends of bars to be thermit welded shall be cut square and smooth. Flame cutting will be permitted provided grinding is employed to remove the resulting scale and to square and smooth the cut ends to a condition equivalent to a saw cut. No shearing will be permitted. Bars shall be cleaned and flame dried before splicing. The joint shall be properly aligned in the mold with a gap opening in accordance with the manufacturer's recommendations. Charging and firing shall conform to the manufacturer's recommendations. The end of bars and the welded mold shall be preheated before welding to a temperature of not less than 100 degrees F and the mold shall be left in place for at least 15 minutes after ignition. Risers shall be broken or burned off after removing the mold. Tension splices shall be staggered longitudinally a minimum of 5 feet so that no more than half of the bars are spliced at any one section or as otherwise indicated.

b. Mechanical Butt-Splices - Mechanical butt-splices shall be an approved exothermic, threaded coupling, swaged sleeve or other positive connecting type. Bars to be spliced by a mechanical butt-splicing process may be sawed, sheared or flame cut provided the ends of sheared bars are reshaped after shearing and all slag is removed from the ends of flame cut bars by chipping and wire brushing prior to splicing. Surfaces to be enclosed within a splice sleeve or coupling shall be cleaned by wire brushing or other approved method prior to splicing. Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories. In addition to the strength requirements specified paragraph BUTT-SPLICES the additional deformation of number 14 and smaller bars due to slippage or other movement within the splice sleeve shall not exceed 0.015 inches (unit strain 0.0015 inches/inch) beyond the elongation of an unspliced bar based upon a 10 inch gage length spanning the extremities of the sleeve at a stress of 30,000 psi. The additional deformation of number 18 bars shall not exceed 0.03 inches (unit strain 0.003 inches/inch) beyond the elongation of an unspliced bar based upon a 10 inch gage length spanning the extremities of the sleeve at a stress of 30,000 psi. The amount of the additional deformation shall be determined from the stress-strain curves of the unspliced and spliced bars tested as required paragraph QUALIFICATION OF BUTT-SPLICING PROCEDURE for qualification of the butt-splicing procedure. Tension splices of number 14 or smaller bar shall be staggered longitudinally a minimum of 5 feet or as otherwise indicated so that no more than half of the bars are spliced at any one section. Tension splices of number 18 bars shall be staggered longitudinally a minimum of 5 feet so that no more than 1/3 of the bars are spliced at any one section.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated.

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Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.4 FIELD TESTS AND INSPECTIONS

3.4.1 Identification of Splices

Establish and maintain an approved method of identification of all field butt-splices which will indicate the splicer and the number assigned each splice made by the splicer.

3.4.2 Examining, Testing, and Correcting

Perform the following during the butt-splicing operations as specified and as directed:

a. Visual Examination - All welded splices shall be visually examined for the presence of cracks, undercuts, inadequate size and other visible defects. Resplined connections resulting from correction of visual defects may be radiographically examined at the option of the Contracting Officer as specified in paragraph SUPPLEMENTAL EXAMINATION. Exothermic mechanical butt-splices shall be visually examined to determine if the filler metal is clearly visible at the tap holes and completely fills the sleeves at both ends except for spaces of not more than 3/8 inch occupied by packing.

b. Tension Tests - Tensions tests to 90 percent of the minimum specified ultimate tensile strength of the spliced bars or to destruction shall be performed on one test specimen made in the field for every 25 splices made. Test specimens shall be made by the splicers engaged in the work, using the approved splicing procedure and the same size bars placed in the same relative position, and under the same conditions as those in the groups represented by the specimens. Stress-strain curves shall be furnished for each butt-splice tested.

c. Radiographic Examination - Not less than one of each 25 welded splices selected at random by the Contracting Officer shall be examined radiographically and evaluated for defects. The greatest dimension of any porosity (gas pocket or similar void) or fusion-type defect (slag inclusion, incomplete fusion or similar generally elongated defect in weld fusion) shall not exceed 1/4 inch. The minimum clearance between edges of porosity or fusion-type defects shall not be less than 1 inch.

d. Correction of Deficiencies - No splice shall be embedded in concrete until satisfactory results of visual examination and the required tests or examinations have been obtained. All splices having visible defects or represented by test specimens which do not satisfy the tests or examinations shall be removed. If any of the tension test

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specimens fail to meet the strength requirements or deformation limitations two production splices from the same lot represented by the test specimens which failed shall be cut out and tension tested. If both of the retests pass the strength requirements and deformation limitations all of the splices in the lot will be accepted. If one or both of the retests fail to meet the strength requirements or deformation limitations all of the splices in the lot will be rejected. All costs of removal, testing and resplicing of the additional production splices shall be borne by the Contractor. The bars of rejected splices shall be cut off outside the splice zone of weld metal, filler metal contact, coupling or sleeve. The cut ends shall be finished as specified and the joints shall be respliced and reinspected at no additional cost.

e. Supplemental Examination - The Contracting Officer may require additional or supplemental radiographic examination and/or tension test of any completed splice.

-- End of Section --

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SECTION 03 30 00.00 40

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117	(2006) Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 211.1	(1991; R 2002) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(2005) Specifications for Structural Concrete
ACI 318/318R	(2008; Errata 2008; Errata 2009) Building Code Requirements for Structural Concrete and Commentary
ACI/MCP-2	(2009) Manual of Concrete Practice Part 2 - ACI 224R-01 to ACI 313R-97
ACI/MCP-3	(2009) Manual of Concrete Practice Part 3:315-99 to 343R-95

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2004; Errata 2004) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.4/D1.4M	(2005; E 2005) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 185/A 185M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 497/A 497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 615/A 615M	(2008b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2008a) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

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ASTM A 767/A 767M	(2005) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775/A 775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 117	(2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(2007) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	(2007a) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138/C 138M	(2009) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143/C 143M	(2008) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150	(2007) Standard Specification for Portland Cement
ASTM C 156	(2005) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2008c) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 233	(2007) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 29/C 29M	(2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

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ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2008a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2005e1e) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 566	(1997; R 2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 70	(2006) Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2007) Standard Specification for Ready-Mixed Concrete
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM E 329	(2008) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2001; 27Ed) Manual of Standard Practice
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NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2007) Construction and Industrial Plywood
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U.S. GENERAL SERVICES ADMINISTRATION (GSA)

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FS MMM-A-001993	(1978) Adhesive, Epoxy, Flexible, Filled (For Binding, Sealing, and Grouting)
FS SS-S-200	(Rev E; Am 2) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Equipment Lists shall be submitted by the Contractor prior to construction in accordance with the paragraph entitled, "General Information," of this section.

SD-03 Product Data

Manufacturer's catalog data for the following items shall include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical floor hardeners.

Concrete Aggregates (recycled & non-recycled)
Portland Cement
Ready-Mix Concrete
Form Facing Materials
Reinforcement Materials
Joint Materials
Bonding Materials
Concrete Curing Materials

SD-05 Design Data

Mix design data for each class of Ready-Mix Concrete including use of recycled concrete material shall be submitted at least 15 calendar days prior to start of specified work; G

SD-06 Test Reports

Test reports for welding electrodes shall be in accordance with AWS A5.1/A5.1M.

Reports for concrete shall be in accordance with the paragraph entitled, "Quality-Control Testing During Construction," of this section. Test reports of the chemical requirements of reinforcing bars shall also be submitted.

Chemical Composition
Mechanical Usability
Soundness

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Slump
Air Entrainment
Compressive Strength

SD-07 Certificates

Welding Procedures shall be in accordance with AWS D1.4/D1.4M.

Mill certificates shall be submitted for Steel Bar according to the paragraph entitled, "Fabrication," of this section.

Certificates for concrete shall be in accordance with the paragraph entitled, "Classification and Quality of Concrete," of this section. Certificates shall contain project name and number, date, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer, brand name of manufactured materials, material name, values as specified for each material, and test results. Certificates for Welder Qualifications shall be in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

Concrete Design Mixes
Concrete Aggregates
Welding Procedures

SD-08 Manufacturer's Instructions

Installation instructions shall indicate the manufacturer's recommended method and sequence of installation for the following items:

Admixtures
Bonding Materials

SD-11 Closeout Submittals

Records of Communication shall be submitted in accordance with paragraph entitled, "General Information," of this section.

1.3 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Concrete testing shall be performed by a Government approved commercial testing laboratory and inspection service experienced in sampling and testing concrete. Testing agency shall meet the requirements of ASTM E 329.

1.4 QUALIFICATIONS FOR WELDING WORK

Welding procedures shall be in accordance with AWS D1.4/D1.4M.

Welder qualifications shall be verified in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders shall be permitted to do only the type of welding for which each is specifically qualified.

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1.5 CONCRETE SAMPLING AND TESTING

Testing by the Contractor shall include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete. Quality control testing during construction shall be performed by the Contractor.

Concrete aggregate materials proposed for use in the work shall be sampled and tested in accordance with ASTM C 33.

Portland cement shall be sampled and tested in accordance with ASTM C 150.

Air-entraining admixtures shall be sampled and tested in accordance with ASTM C 233.

1.6 CONCRETE DESIGN MIXES

Mix proportions for each concrete class shall be determined and tested as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Specific gravity absorption of fine aggregate	ASTM C 128	As required for the concrete aggregate for each trial mix
Specific gravity and absorption of coarse aggregate	ASTM C 127	
Gradation of fine and coarse aggregates	ASTM C 117 and ASTM C 136	
Moisture content of both fine and coarse aggregates	ASTM C 70 and ASTM C 566	
Dry-rodded unit weight of coarse aggregate	ASTM C 29	
Trial mixes using at least three different water/cement ratios, minimum allowable cement content, maximum allowable slump; both with and without air entrainment	ACI 211.1	As required to determine the concrete mix having the properties specified for each concrete class

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Making and curing concrete specimens in the laboratory	ASTM C 192	Two sets of three specimens for each design mix
Sampling fresh concrete in the laboratory	ASTM C 192	One for each set of design mix specimens
Slump	ASTM C 143	
Air content	ASTM C 231	
Yield	ASTM C 138	
Compressive strength	ASTM C 39	Three specimens tested at 7 days, and three specimens tested at 28 days for each mix design

Proportions of concrete mixtures shall be determined in accordance with ACI/MCP-2 and Method 1 of ACI 301, Section 3.8.2.1. Separate curves shall be prepared for air-entrained and non-air-entrained concretes.

1.7 DELIVERY AND STORAGE OF MATERIALS

Packaged materials shall be delivered to the project site in their original, unopened package or container bearing label clearly identifying manufacturer's name, brand name, material, weight or volume, and other pertinent information. Packaged materials shall be stored in their original, unbroken package or container in a weathertight and dry place until ready for use in the work.

Unpackaged aggregates shall be stored to avoid excessive segregation, contamination with other materials or other size aggregates, or freezing.

Reinforcement and other metal items shall be protected from corrosion and shall be kept free from ice, grease, and other coatings that would destroy or reduce bond.

1.8 GENERAL INFORMATION

Construction Equipment Lists of major components used during this phase of work shall be submitted prior to construction.

Letters of record expressing Communication between the Contractor and Contracting Officer shall be provided after the contract completion.

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PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

2.1.1 General

All concrete materials for cast-in-place concrete, except for concrete bulkheads, shall conform Portland Cement Concrete, Class S as defined in Section 1006 of the Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition, except as modified herein.

2.1.2 Portland Cement

Cement shall conform to ASTM C 150, Type II. One brand and type of cement shall be used for formed concrete having exposed-to-view finished surfaces.

2.1.3 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement + pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.1.4 Recycled Concrete Aggregate

When natural sand is used, up to 30% of natural crushed coarse aggregate can be replaced with coarse recycled aggregate. Between 10% and 20% of natural fine aggregates may be replaced with recycled fine aggregates.

2.2 FORM FACING MATERIALS

2.2.1 Concrete Form Plywood (Standard Rough)

Plywood shall conform to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.2.2 Overlaid Concrete Form Plywood (Standard Smooth)

Plywood shall conform to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.3 REINFORCEMENT MATERIALS

See Section 03 20 01.00 10 Concrete Reinforcing for requirements.

2.4 JOINT MATERIALS

2.4.1 Preformed Joint Filler Strips

Filler strips shall be nonextruding and resilient nonbituminous type conforming to ASTM D 1752, Type I or II.

2.4.2 Joint Sealant Compound

Compound shall be cold-applied, two-component, elastomeric polymer type conforming to FS SS-S-200.

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2.5 BONDING MATERIALS

2.5.1 Concrete Bonding Agent

Agent shall be an aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound suitable for brush or spray application conforming to ASTM C 932.

2.5.2 Epoxy-Resin Adhesive Binder

Binder shall be two-component, epoxy-polysulfide polymer type with an amine-type curing-agent conforming to FS MMM-A-001993, Type I or ASTM C 881.

2.6 CONCRETE CURING MATERIALS

2.6.1 Absorptive Cover

Cover for curing concrete shall be burlap cloth made from jute or kenaf, weighing 9 ounces plus or minus 5 percent per square yard when clean and dry, conforming to ASTM C 171, Class 3; or cover may be cotton mats as approved.

2.6.2 Moisture-Retaining Cover

Cover for curing concrete shall be waterproof paper conforming to ASTM C 171, regular or white, or polyethylene sheeting conforming to ASTM C 171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap shall conform to ASTM C 171, Class 3, and polyethylene film shall conform to ASTM C 171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material shall not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.6.3 Water

Water shall be potable.

2.6.4 Membrane-Forming Curing Compound

Compound shall be liquid type conforming to ASTM C 309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

PART 3 EXECUTION

3.1 FORMWORK

3.1.1 General

Forms shall be constructed to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms shall be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.1.2 Design and Construction of Form work

Form work design and construction shall conform to ACI/MCP-2 and ACI 301, Chapter 4.

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Forms shall be tight to prevent leakage of cement paste during concrete placing.

Form facing materials shall be supported by structural members spaced close to prevent deflection of form facing material. Forms placed in successive units for continuous surfaces shall be fitted to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, formwork shall be cambered for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Exposed joints, edges, and external corners shall be chamfered a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Shores and struts shall be provided with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Adjustment shall be obtained with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, trussed supports shall be provided.

Temporary openings shall be provided in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Forms shall be readily removable without impact, shock, or damage to concrete.

3.1.3 Forms for Standard Rough Form Finish

Rough form finish shall be given concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish shall be the specified concrete form plywood or other approved form facing material that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Horizontal joints shall be level and vertical joints shall be plumb.

3.1.4 Forms for Standard Smooth Form Finish

Smooth form finish shall be given concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish shall be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales shall not exceed 0.0025 times the span.

Arrangement of form facing sheets shall be orderly and symmetrical, and sheets shall be in sizes as large as practical.

Panels shall be arranged to make a symmetrical pattern of joints. Horizontal and vertical joints shall be solidly backed and butted tight to prevent leakage and fins.

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3.1.5 Form Ties

Ties shall be factory fabricated metal, adjustable in length, removable or snap-off type that will not allow form deflection or will not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts shall be at least 1-1/2 inches back from concrete surface. Form ties shall be free of devices that will leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.1.6 Tolerances for Form Construction

Formwork shall be constructed to ensure that after removal of forms and prior to patching and finishing of formed surfaces, concrete surfaces shall be in accordance with tolerances specified in ACI 117 and ACI/MCP-2.

3.1.7 Preparation of Form Surfaces

Contact surfaces of forms shall be coated with form-coating compound before reinforcement is placed. Form-coating compound shall be a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Excess form-coating compound shall not be allowed to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete will be placed. Thinning of form-coating compound shall be made with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.1.8 Removal of Forms

Formwork that does not support weight of concrete, such as sides of beams, walls, columns, and similar vertical parts of the work, may be removed 24 hours after placing concrete, provided concrete is sufficiently hard not to be damaged from form-removal operations.

Formwork that supports weight of concrete, such as beam soffits, slabs, and similar horizontal parts of the work, shall remain in place at least until concrete has attained design minimum laboratory compressive strength at 28 days for applicable concrete class specified.

Form facing material may be removed before concrete has attained its required 28-day compressive strength but in no case less than 6 days after placing concrete, provided shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports. Shores and other vertical supports shall remain in place until concrete has attained its required 28-day compressive strength.

Results of control tests will be used as evidence that concrete has attained sufficient strength to permit removal of supporting forms. Test specimens shall be removed from molds at the end of 24 hours and stored in the structure as near points of sampling as possible; shall receive same protection from elements during curing as is given those portions of the structure which they represent; and shall not be removed from the structure for transmittal to the laboratory prior to expiration of three-fourths of proposed period before removal of forms. Supporting forms of shoring shall not be removed until strength of control-test specimens has attained a value of at least 1,500 psi for columns and 2,000 psi for other work. Contractor shall ensure that newly unsupported portions of the structure are not subjected to heavy construction or material loading.

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Tie-rod clamps to be removed from wall shall be loosened 24 hours after concrete is placed; form ties, except for a sufficient number to hold forms in place, may be removed at that time. Ties wholly withdrawn from wall shall be pulled toward inside face.

When formwork is removed during concrete curing period, exposed concrete shall be cured as specified.

3.1.9 Re-Use of Forms

Surfaces of forms that are to be re-used shall be cleaned and repaired, except that split, frayed, or delaminated form facing material shall not be re-used. Contact surfaces of re-used forms shall be coated as specified.

3.2 REINFORCEMENT FABRICATION AND INSTALLATION

See Section 03 20 01.00 10 Concrete Reinforcing for requirements.

3.3 JOINTS

3.3.1 Construction Joints

Joints not indicated shall be made and located so as not to impair strength and appearance of the structure and shall be as approved. Construction joints shall be located as follows:

In grade beams at not more than 30 feet in any horizontal direction.

In slabs on ground, so as to divide slab into areas not in excess of 120 square feet

Keyways at least 1-1/2-inches deep shall be provided in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints shall be perpendicular to main reinforcement. Reinforcement shall be continued across construction joints.

3.3.2 Control Joints in Slabs on Ground

Joints shall be provided to form panels as indicated.

Under and on exact line of each control joint, 50 percent of welded wire fabric reinforcement shall be cut before placing concrete.

Joints shall be 1/8-inch wide by 1/5 to 1/4 of slab depth and shall be formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor shall remove inserts and clean groove of foreign matter and loose particles.

3.3.3 Sealing Joints in Slabs on Ground

Isolation and control joints which will not be covered with finish flooring material shall be sealed with joint sealing compound after concrete curing period. Groove shall be slightly underfilled with joint sealing compound to prevent extrusion of compound. Excess material shall be removed as soon after sealing as possible.

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Sealing shall not be required for isolation and control joints which will be covered with finish flooring material. Groove shall be left ready to receive filling material that will be provided as part of finish floor covering work.

3.4 INSTALLATION OF ANCHORAGE DEVICES

3.4.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, cast-in-place concrete shall be set and built in as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.4.2 Placing Anchorage Devices

Anchorage devices and embedded items shall be positioned accurately and supported against displacement. Openings in anchorage devices such as slots and threaded holes shall be filled with an approved, removable material to prevent entry of concrete into openings.

3.5 PLACEMENT OF CONCRETE FOR TUNNEL BULKHEADS

Where the new fence foundation does not block or does not completely block the found tunnel, the Contractor shall place a concrete to complete the tunnel bulkhead. The tunnel bulkhead shall extend to the limits described in Section 31 00 00 Earthwork and shall stop 12" below finish grade. Concrete required to complete the tunnel bulkhead shall be placed against a solid steel plate blocking off the tunnel. The width of the bulkheads shall be at least 18" thick. Concrete shall be placed in bulkheads shall not require reinforcing steel but shall conform to all other requirements of this section. See Section 01 00 50 for existing tunnel procedures.

3.6 PREPARATIONS FOR CONCRETE PLACING

3.6.1 General

Surfaces against which concrete is to be placed shall be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing. Standing water shall be removed prior to placement of concrete. Sub-grade surface shall be sprinkled with water as required to eliminate suction at the time concrete is deposited.

3.6.2 Sub-grade Under Foundations, Footings and Slabs

See Earthwork Section 31 00 00 for sub-grade preparation requirements.

3.6.3 Formwork

Formwork where used shall be complete and approved. Debris and foreign material shall be removed from interior of forms before start of concrete placing.

3.6.4 Edge Forms and Screed Strips for Slabs/Pads

Edge forms or bulkheads and intermediate screed strips for slabs/pads shall be set to obtain indicated elevations and contours in finished slab/pad surface and shall be strong to support vibrating bridge screeds or roller pipe screeds if nature of specified slab/pad finish requires use of such equipment. Concrete surface shall be aligned to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

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3.6.5 Reinforcement and Other Embedded Items

Reinforcement, joint materials, and other embedded materials shall be secured in position, inspected, and approved before start of concrete placing.

3.7 CONCRETE CONVEYING

3.7.1 Transfer of Concrete At Project Site

Concrete shall be handled from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which will prevent segregation and loss of concrete mix materials.

3.7.2 Mechanical Equipment for Conveying Concrete

Equipment shall ensure a continuous flow of concrete at delivery end and shall be as approved. Runways for wheeled concrete-conveying equipment shall be provided from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment shall be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

3.8 CONCRETE PLACING

3.8.1 Weather Limitations and Protection

Concrete shall not be placed when the temperature of the concrete exceeds 90 degrees F, nor when the ambient temperature is below 40 degrees F, nor during rain, sleet, or snow, unless protection is provided, nor after 90-minutes from the time shown on the batch ticket to the time of placement.

When concrete is placed at 90 degree F or better it shall be covered and kept continuously wet for a minimum of 48 hours. Protection shall be provided during cold weather in accordance with ACI/MCP-2 and ACI 301.

During inclement weather, protection material shall be watertight to prevent entry of rain, sleet, or snow onto surfaces to receive concrete and into fresh concrete.

Protection materials shall be stored at project site for use in event of unforeseen weather changes after start of concrete placing operations.

3.8.2 General Placing Requirements

Concrete shall be deposited continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be provided as specified. Concrete placing shall be performed at such a rate that concrete which is being integrated with fresh concrete is still plastic. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to procedures which will cause segregation.

Concrete which becomes non-plastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials shall not be used. Use of retempered concrete will not be permitted. Rejected concrete shall be removed from the site.

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3.8.3 Placing Concrete in Forms

Temporary spreaders in forms shall be removed when concrete placing has reached elevation of spreaders.

Concrete placed in forms shall be consolidated by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Vibrators shall be designed to operate with vibratory element submerged in concrete and shall maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Vibrating equipment shall be adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement shall not be permitted. Vibrators shall not be used to transport concrete inside forms. Vibrators shall be inserted and withdrawn vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Vibrator shall not be inserted into lower courses of concrete that have begun to set. At each insertion, duration of vibration shall be limited to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Placing of concrete in supporting elements shall not be started until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.4 Placing Concrete on Grade

Concrete for foundations and slabs shall be placed and consolidated in a continuous operation, within the limits of approved construction joints if any until placing of panel or section is completed.

During concrete placing operations, concrete shall be consolidated by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items. Concrete placed in supported slabs or pads shall be consolidated by mechanical vibrators as directed. Otherwise concrete in slabs/pads shall be consolidated by vibrating bridge screeds, roller pipe screeds, or other approved method. Consolidation operations shall be limited to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated shall be as dry as practical and surfaces thereof shall not be manipulated prior to finishing operations. Concrete shall be brought to correct level with a straightedge and struck-off. Bull floats or darbies shall be used to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface shall not be permitted.

3.8.5 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, shall be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Surfaces shall be roughened in a manner that will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Bonding of fresh concrete that has set shall be obtained as follows:

At joints between concrete construction elements unless otherwise specified; roughened and cleaned surface of set concrete shall be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at supported slabs, and other structural members; and at joints in work exposed to liquids; the roughened and cleaned surface of set concrete shall be dampened but not saturated and covered with a cement grout coating.

Cement grout shall consist of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Cement grout shall be applied with a stiff broom

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or brush to a minimum thickness of 1/16 inch. Fresh concrete shall be deposited before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Such bonding material shall be applied to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 FINISHING OF FORMED SURFACES

3.9.1 Repairing and Patching Defective Areas

Immediately after removal of forms, defective areas above finish grade shall be repaired and patched with cement mortar. Honeycomb, rock pockets, voids over 1/2 inch in diameter, and holes left by tie rods and bolts shall be cut out to solid concrete, but in no case to a depth of less than 1 inch. Edges of cuts shall be perpendicular to surface of concrete. Before placing cement mortar, area to be patched at least 6 inches adjacent thereto shall be cleaned, dampened with water, and brush coated with neat Portland cement grout. Cement mortar for patching shall consist of one part standard Portland cement to two parts fine aggregate passing No. 16 mesh sieve and as little water as necessary for handling and placing. Portland cement portion of cement mortar shall be a blend of white and standard Portland cement so that when dry, cement mortar will match surrounding concrete in color. Cement mortar shall be compacted in place and struck off slightly higher than the surrounding surface. Holes extending through concrete shall be filled by means of a plunger type gun or other suitable device from unexposed face, using a stop held at exposed face to ensure complete filling.

3.9.2 Standard Rough Form Finish

Formed concrete below finish grade shall be standard rough form finish. Rough finish shall be the concrete surface having texture imparted by form facing material used, defective areas repaired and patched as specified, and fins and other projections exceeding 1/4 inch in height rubbed down with wood blocks.

3.9.3 Standard Smooth Finish

Formed concrete above grade shall be standard smooth finish. Smooth finish shall be as-cast concrete surface as obtained with form facing material for standard smooth finish. Defective areas shall be repaired and patched as specified; and all fins and other projections on surface shall be removed.

3.9.4 Related Unformed Surfaces

Tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck off smooth after concrete is placed and shall be finished to a texture matching that of adjacent formed surfaces. Final surface treatment on formed surfaces shall continue uniformly across adjacent unformed surfaces.

3.10 FINISHING OF SLABS AND CHANNELS

3.10.1 Scratch Finish

After placing concrete slabs, surface shall be plane to a tolerance not exceeding 1/4 inch in 2 feet when tested with a 2-foot straightedge placed on the surface at not less than two different angles. Surfaces shall be uniformly sloped to drain. After leveling, surface shall be roughened with stiff brushes or raked before final set.

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3.11 CONCRETE CURING AND PROTECTION

3.11.1 General

Freshly placed concrete shall be protected from premature drying and cold or hot temperature and shall be maintained without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Initial curing shall start as soon as free water has disappeared from surface of concrete after placing and finishing. Concrete shall be kept moist for minimum 72 hours.

Final curing shall immediately follow initial curing and before concrete has dried. Final curing shall continue until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Rapid drying at end of final curing period shall be prevented.

3.11.2 Curing Methods

Curing shall be accomplished by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Moisture curing shall be accomplished by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Absorptive cover shall be placed to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Moisture-retaining cover curing shall be accomplished by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Cover shall be placed directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Cover shall be weighted to prevent displacement; tears or holes appearing during curing period shall be immediately repaired by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Membrane curing shall be accomplished by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Curing compound shall be applied uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Second coat shall be applied in a direction at right angles to direction of first coat. Total coverage for two coats shall be not more than 200 square feet per gallon of curing compound. Concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by method and at rate specified.

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Continuity of coating shall be maintained for entire curing period and damage to coating during this period shall be repaired immediately.

Membrane-curing compounds shall not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.3 Curing Formed Surfaces

Curing of formed surfaces shall be accomplished by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, final curing of formed surfaces shall be accomplished by any of the curing methods specified above, as applicable.

3.11.4 Curing Unformed Surfaces

Initial curing of unformed surfaces, such as monolithic slabs/pads shall be accomplished by membrane curing.

Unless otherwise specified, final curing of unformed surfaces shall be accomplished by any of curing methods specified above, as applicable.

3.11.5 Temperature of Concrete During Curing

When temperature of atmosphere is 40 degrees F and below, temperature of concrete shall be maintained at not less than 50 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, arrangements shall be made before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which will cause too rapid drying of concrete, arrangements shall be made before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete shall be uniform and shall not exceed 5 degrees F in any 1 hour nor 50 degrees F in any 24-hour period.

3.11.6 Protection from Mechanical Injury

During curing period, concrete shall be protected from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.7 Protection After Curing

Finished concrete surfaces shall be protected from damage by construction operations.

3.12 QUALITY-CONTROL TESTING DURING CONSTRUCTION

Concrete shall be sampled and tested for quality control by the Contractor during the placement of the concrete as follows:

<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
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Sampling fresh concrete	ASTM C 172 except modified for slump per ASTM C 94	As required for each test
Slump test	ASTM C 143	One for each concrete load at point of discharge and one for each set of compressive strength tests
Air content by pressure method	ASTM C 231	One for each set of compressive strength tests
Compression test specimens	ASTM C 31	One set of six standard cylinders for each compressive strength test
Concrete temperature		Hourly when air temperature is 40 degrees F or below and 80 degrees F or above; each time a set of compression test specimens is made
Compressive strength test	ASTM C 39	One set for each 150 cubic yards or fraction thereof of each concrete class placed in any one day; two specimens tested at 7 days, three specimens tested at 28 days and one specimen retained in reserve for testing if required

Test reports for concrete for Chemical Composition, Mechanical Usability and Soundness shall be submitted by the Contractor meeting all design specifications as required by referenced standards within this section.

3.13 INSPECTION AND ACCEPTANCE PROVISIONS

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3.13.1 Evaluation of Compressive Strength Tests

Concrete quality control test will be evaluated as specified.

Compressive strength tests will be considered satisfactory if the average of all sets of five consecutive compressive strength tests equal or exceed the 28-day design compressive strength, or if no individual compressive strength test (average of two cylinders) falls below the required 28-day design compressive strength by more than 500 pounds per square inch.

If compressive strength tests fail to meet minimum requirements specified, concrete represented by such tests will be considered deficient in strength and subject to provisions specified.

3.13.2 Strength of Concrete Structure

Strength of concrete structure in place will be considered deficient if it fails to comply with requirements which control strength of structure, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.13.3 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, cores drilled from hardened concrete for compressive strength determination shall be made in accordance with ASTM C 42/C 42M, and as follows:

At least three representative cores shall be taken from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Cores shall be tested after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent will be more than superficially wet under service.

Cores shall be air dried, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and shall be tested dry if concrete they represent will be dry under service conditions.

Strength of cores from each member or area will be considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

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Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required shall be borne by the Contractor.

Core holes shall be filled solid with patching mortar and finished to match adjacent concrete surfaces.

Concrete work that is found inadequate by core tests shall be corrected in a manner approved by the Contracting Officer.

-- End of Section --

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SECTION 03 37 13

SHOTCRETE
11/09

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Shotcrete

1.1.1.1 Payment

Payment will be made for all costs associated with furnishing, delivering, and placing shotcrete.

1.1.1.2 Measurement

Shotcrete will be measured for payment based upon the quantity per cubic yard, based on the area shotcreted to the thickness shown on the contract drawings.

1.1.1.3 Unit of Measure

Unit of measure: cubic yard.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI CP-60	(2009) Craftman Workbook for ACI Certification of Shotcrete Nozzleman
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ASTM INTERNATIONAL (ASTM)

ASTM A820/A820M	(2011) Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
ASTM C1077	(2011c) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1140/C1140M	(2011) Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels
ASTM C1141/C1141M	(2008) Standard Specification for Admixtures for Shotcrete
ASTM C1240	(2011) Standard Specification for Silica Fume Used in Cementitious Mixtures

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ASTM C1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C1567	(2011) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C231/C231M	(2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C266	(2008e1) Standard Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles
ASTM C309	(2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C33/C33M	(2011a) Standard Specification for Concrete Aggregates
ASTM C42/C42M	(2011) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C566	(1997; R 2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM C595/C595M	(2011) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C685/C685M	(2011) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C881/C881M	(2010) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C94/C94M	(2011b) Standard Specification for Ready-Mixed Concrete

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U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400

(1963) Requirements for Water for Use in
Mixing or Curing Concrete

1.3 SYSTEM DESCRIPTION

1.3.1 Strength

Final acceptance of the shotcrete will be based on compressive strength results obtained from cores.

1.3.2 Compressive Strength

The required compressive strength of cores shall not be less than 4000 psi at 28 days age when tested in accordance with ASTM C42/C42M. The average compressive strength of cores taken from the structure, representing a shift or not more than 50 cubic yards of shotcrete tested at 28 days of age, shall equal or exceed the required compressive strength specified with no individual core less than 85 percent of the required compressive strength. When the length of a core is less than 1.94 times the diameter, the correction factors given in ASTM C42/C42M will be applied to obtain the compressive strength of individual cores.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Mixture Proportions; G
Aggregates
Accelerator Compatibility; G
Preconstruction Test Panels

SD-07 Certificates

Portland Cement; G
Pozzolans
Silica Fume
Accelerating Admixtures; G
Curing Materials; G
Steel Fiber Reinforcement; G
Qualifications; G

1.5 QUALITY ASSURANCE

Provide facilities and labor, as may be necessary, for obtaining and testing representative test samples. Shotcrete shall be sampled and tested by the method given in paragraph STRENGTH TESTING in PART 3.

1.5.1 Qualifications

Shotcrete will be produced by either the Dry or Wet Method. Submit a resume for each nozzleman certifying that each has not less than 1 year's

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experience for the particular type of shotcrete to be applied. The resume shall include company name, address, and telephone number, name of supervisor, and detailed description of work performed. All nozzlemen shall be certified in accordance with ACI CP-60. Qualifications of additional nozzlemen throughout the job shall be similarly submitted for approval.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials shall be portland cement, blended hydraulic cement, portland cement in combination with pozzolan or ground granulated blast-furnace slag (GGBFS), or portland cement in combination with silica fume conforming to appropriate specifications listed below.

2.1.1.1 Portland Cement

Portland cement shall meet the requirements of ASTM C150/C150M Type II. Submit certificate of compliance with all specification requirements.

2.1.1.2 Blended Hydraulic Cement

ASTM C595/C595M Type IS, IP.

2.1.1.3 Pozzolan Other Than Silica Fume

Pozzolans shall conform to ASTM C618, Class C, with the optional requirements for [available alkalies from Table 1A] multiple factor, drying shrinkage, and uniformity of Table 2A. Submit certificate of compliance for fly ash and other pozzolans with all specification requirements.

2.1.1.4 Silica Fume

Silica may be furnished as a dry, densified material or as a slurry. Silica fume, unprocessed, or before processing into a slurry or a densified material, shall conform to ASTM C1240. Submit certificate of compliance for silica fume with all specification requirements.

2.1.2 Aggregates

Submit Supplier's test reports for aggregates showing the materials meet the requirements of this specification. Aggregates shall conform to ASTM C33/C33M with the combined grading of coarse and fine aggregates conforming to the grading shown below.

PERCENT BY MASS PASSING INDIVIDUAL SIEVES			
SIEVE SIZE	GRADING NO. 1	GRADING NO. 2	GRADING NO. 3*
(3/4 in.)	--	--	100
(1/2 in.)	--	100	80-95
(3/8 in.)	100	90-100	70-90

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(No. 4)	95-100	75-85	50-70
(No. 8)	80-100	50-70	35-55
(No. 16)	50-85	35-55	20-40
(No. 30)	25-60	20-35	10-30
(No. 50)	10-30	8-20	5-17
(No. 100)	2-10	2-10	2-10

* Fine and coarse aggregates shall be "tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C1260. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor's proposed mix design proportioning. All results of the separate and combination testing shall have a measured expansion less than 0.10 (0.08) percent at 16 days after casting. Should the test data indicate an expansion of 0.10 (0.08) percent or greater, the aggregate(s) shall be rejected or additional testing using ASTM C1260 and ASTM C1567 shall be performed. The additional testing using ASTM C1260 and ASTM C1567 shall be performed using the low alkali portland cement in combination with ground granulated blast furnace (GGBF) slag, or Class F fly ash. GGBF slag shall be used in the range of 40 to 50 percent of the total cementitious material by mass. Class F fly ash shall be used in the range of 25 to 40 percent of the total cementitious material by mass."

2.1.3 Water

Use fresh, clean, potable mixing water or nonpotable water which meets the requirements of COE CRD-C 400.

2.1.4 Admixtures

a. Admixtures to be used, when required or approved, shall comply with the appropriate sections of ASTM C1141/C1141M. Except as otherwise accepted, soluble admixtures shall be dissolved in water before introduction into the shotcrete mixture.

b. When accelerating admixtures complying with ASTM C1141/C1141M, Type II, Grade 1, are to be used, establish the accelerator compatibility of the job cement and the proposed accelerators using ASTM C266, except as modified herein. The powdered accelerator shall be blended with 1.25 ounces of cement until uniform and 0.004 gal of water shall then be added. The liquid accelerator shall first be mixed with 0.004 gal of water and then added to 1.25 ounces of cement. Three percent of the proposed accelerator by mass of cement shall be used as a starting point. Mixing shall be accomplished within 15 seconds. The specimen shall be molded within 1 minute of adding the mixing water. If initial set is 2 minutes or less and a final set is 10 minutes or less, the accelerator is considered compatible. If these values are not achieved in the first test, additional tests shall be run using 2 percent and 4 percent of accelerator. Submit document establishing the compatibility of the job cement and the proposed accelerators and certificate of

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compliance for accelerating admixtures with all specification requirements.

2.1.5 Curing Materials

Submit certificate of compliance for curing materials with all specification requirements. Curing materials shall meet the following requirements.

2.1.5.1 Impervious Sheet Materials

ASTM C171, type optional except polyethylene film, if used, shall be white opaque.

2.1.5.2 Membrane-Forming Curing Compound

ASTM C309, Type 1-D or Type 2.

2.1.6 Reinforcement

2.1.6.1 Steel Fiber Reinforcement

Steel fiber reinforcement shall meet the requirements of ASTM A820/A820M. Submit certificate of compliance for fiber reinforcement with all specification requirements.

2.1.7 Air Content

Air-entraining admixture shall be used in such proportion that the air content of the shotcrete prior to gunning shall be plus or minus (\pm) 1.0 percent as determined by ASTM C231/C231M.

2.1.8 Air Supply

Provide a supply of clean, dry air adequate for maintaining sufficient nozzle velocity for all parts of the work and, if required, for simultaneous operation of a suitable blowpipe for clearing away rebound.

2.2 MIXTURE PROPORTIONS

Mixture proportions and test data from prior experience within 2 years, if available, may be submitted for approval. If test data from experience are not available or accepted, specimens shall be made and tested from mixtures having three or more different proportions. The recommended mixture proportions, sources of materials, and all test results shall be submitted for acceptance.

2.3 EQUIPMENT

2.3.1 Dry Mix Batching and Mixing

Aggregate and cementitious materials may be batched by mass or by volume. Equipment for batching by mass shall be capable of the accuracy specified in ASTM C94/C94M. Volumetric equipment shall be capable of batching with the accuracy specified in ASTM C685/C685M. The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity and be capable of discharging all mixed material without any carryover from one batch to the next.

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2.3.2 Delivery Equipment for Dry Mix

The equipment shall be capable of discharging the aggregate-cement mixture into the delivery hose and delivering a continuous smooth stream of uniformly mixed material to the discharge nozzle. The discharge nozzle shall be equipped with a manually operated water injection system (water ring) for directing an even distribution of water through the aggregate-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water and shall be convenient to the nozzleman. The water pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to ensure that the water is completely mixed with the other materials. If the line water pressure is inadequate, a water pump shall be introduced into the line. The water pressure shall be steady (nonpulsating). The delivery equipment shall be thoroughly cleaned at the end of each shift. Equipment parts, especially the nozzle liner and water ring, shall be regularly inspected and replaced as required.

2.3.3 Wet Mix Batching and Mixing

Batching and mixing shall be accomplished in accordance with the applicable provisions of ASTM C94/C94M. If volumetric batching and mixing are used, the materials shall be batched and mixed in accordance with the applicable provisions of ASTM C685/C685M. The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous placing. Ready-mix shotcrete complying with ASTM C94/C94M may be used.

2.3.4 Delivery Equipment for Wet Mix

The equipment shall be capable of delivering the premixed materials accurately, uniformly, and continuously through the delivery hose. Recommendations of the equipment manufacturer shall be followed on the type and size of nozzle to be used and on cleaning, inspection, and maintenance of the equipment.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES

3.1.1 Earth

Earth shall be compacted and trimmed to line and graded before placement of shotcrete. Surfaces to receive shotcrete shall be dampened.

3.1.2 Existing Concrete

All unsound and loose materials shall be removed by sandblasting, grinding, or high-pressure water jets before applying shotcrete. Any area to be repaired shall be chipped off or scarified to remove offsets which would cause an abrupt change in thickness without suitable reinforcement. Edges shall be tapered to leave no square shoulders at the perimeter of a cavity. The surface shall be dampened but without visible free water.

3.1.3 Rock

Rock surfaces shall be cleaned to remove loose or drummy material, mud, running water, and other foreign matter that will prevent bond of the shotcrete. The rock surface shall be dampened prior to placement of

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shotcrete.

3.1.4 Shotcrete

When a layer of shotcrete is to be covered by a succeeding layer at a later time, it shall first be allowed to develop its initial set. Then all laitance, loose material, and rebound shall be removed by brooming or scraping. Hardened laitance set shall be removed by sandblasting and the surface thoroughly cleaned.

3.1.5 Construction Joints

Unless otherwise specified, construction joints shall be tapered to a shallow edge form, about 1 inch thick. If nontapered joints are specified, take special care to avoid or remove trapped rebound at the joint. The entire joint shall be thoroughly cleaned and wetted prior to the application of additional shotcrete.

3.2 PLACEMENT OF SHOTCRETE

3.2.1 General

Place shotcrete using suitable delivery equipment and procedures. The area to which shotcrete is to be applied shall be clean and free of rebound or overspray.

3.2.2 Placement Techniques

3.2.2.1 Placement Control

Thickness, method of support, air pressure, and water content of shotcrete shall be controlled to preclude sagging or sloughing off. Shotcreting shall be discontinued or suitable means shall be provided to screen the nozzle stream if wind or air currents cause separation of the nozzle stream during placement.

3.2.2.2 Corners

Horizontal and vertical corners and any area where rebound cannot escape or be blown free shall be filled first.

3.2.3 Placement Around Reinforcement

The nozzle shall be held at such distance and angle to place material behind reinforcement before any material is allowed to accumulate on the face of the reinforcement. In the dry-mix process, additional water may be added to the mixture when encasing reinforcement to facilitate a smooth flow of material behind the bars. Shotcrete shall not be placed through more than one layer of reinforcing steel rods or mesh in one application unless demonstrated by preconstruction tests that steel is properly encased.

3.2.4 Cover of Reinforcement

The following minimum cover shall be provided.

- a. For shotcrete used as linings, coatings, slab, or wall: 3/4 inch.

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3.2.5 Placement Precautions

The following precautions shall be taken during placement.

- a. Placement shall be stopped if drying or stiffening of the mixture takes place at any time prior to delivery to the nozzle.
- b. Rebound or previously expended material shall not be used in the shotcrete mixture.

3.3 REPAIR OF DEFECTS

3.3.1 Defects

Defective areas larger than 48 square inches or 2 inches deep shall be removed and replaced with fresh shotcrete. These defects include honeycombing, lamination, dry patches, voids, or sand pockets. Defective areas shall be removed in accordance with the procedures described in paragraph EXISTING CONCRETE and replaced with fresh shotcrete.

3.3.1.1 Repairs

All repairs shall be made within 1 week of the time the deficiency is discovered. All unacceptable materials shall be removed and repaired by the procedures described in the following two paragraphs. Voids and holes left by the removal of tie rods in all permanently exposed surfaces not to be backfilled and in surfaces to be exposed to water shall be reamed and completely filled with dry-patching mortar as specified below.

3.3.1.2 Minor Patching

Minor patching may be accomplished with a dry-pack mixture, or with materials as approved by the Contracting Officer. Patches that exceed 0.1 cubic foot in volume shall receive a brush coat of approved epoxy resin meeting ASTM C881/C881M, Type II, as a prime coat. Care shall be taken not to spill epoxy or overcoat the repair surface so that the epoxy runs or is squeezed out onto the surface which will remain exposed to view. Epoxy resin shall be used in strict conformance with manufacturer's recommendations with special attention paid to pot life, safety, and thin film tack time.

3.3.2 Core Holes

Core holes shall not be repaired with shotcrete. Instead, they shall be filled solid with a dry-pack mixture after being cleaned and thoroughly dampened.

3.4 FINISHING

3.4.1 Natural Gun Finish

Unless otherwise specified, provide undisturbed final layer of shotcrete as applied from nozzle without hand finishing.

3.4.2 Cutting Screed

After the surface has taken its initial set (crumbling slightly when cut), excess material outside the forms and ground wires shall be sliced off with a downward cutting motion using a sharp-edged cutting screed.

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3.4.3 Flash Coat

A thin coat of shotcrete containing finer sand applied from a distance greater than normal shall be applied to the surface as soon as possible after the screeding.

3.4.4 Float and Trowel Finish

Final surface finish shall be provided using wood float. Troweling of thin sections of shotcrete shall be avoided unless both troweling and commencement of moisture curing take place within a relatively short period after placement of shotcrete.

3.4.5 Fiber-Reinforced Shotcrete

Finish the outer surface of the structure with a layer of nonfiber-reinforced shotcrete and provide an appropriate finish as denoted.

3.5 CURING AND PROTECTION

3.5.1 Initial Curing

Immediately after finishing, shotcrete shall be kept continuously moist for at least 3 days. One of the following materials or methods shall be used:

- a. Ponding or continuous sprinkling.
- b. Absorptive mat or fabric, sand, or other covering kept continuously wet.
- c. Curing Compounds. On natural gun or flash finishes, use the coverage application requirement of 100 square feet/gallon or twice the manufacturer's requirement, whichever is less. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitious finishing materials are to be bonded unless positive measures, such as sandblasting, are taken to completely remove curing compounds prior to the application of such additional materials.

3.5.2 Final Curing

Additional curing shall be provided immediately following the initial curing and before the shotcrete has dried. One of the following materials or methods shall be used:

- a. Continue the method used in initial curing.
- b. Application of impervious sheet material conforming to ASTM C171.

3.5.3 Formed Surface

If forms are to be removed during curing period, one of the curing materials or methods listed in paragraph INITIAL CURING shall be used immediately. Such curing shall be continued for the remainder of the curing period.

3.5.4 Duration of Curing

Curing shall be continued for the first 7 days after shotcreting or until

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the specified compressive strength of the in-place shotcrete as determined by specimens obtained and tested in accordance with ASTM C42/C42M is achieved.

3.5.5 Temperature Considerations

The air temperature in contact with the shotcrete shall be continuously maintained at a temperature above 40 degrees F for at least 3 days after placement. No shotcrete shall be applied when the concrete surface or air in contact with the concrete surface is below 40 degrees F.

3.6 TESTS

3.6.1 Strength Testing

Test specimens shall be initially cured onsite, then shall be transported in an approved manner to an approved testing laboratory meeting the requirements of ASTM C1077 within 48 hours of scheduled testing time.

3.6.1.1 Test Cores

Test cores shall be drilled from the structure at least 40 hours prior to testing and tested in accordance with ASTM C1140/C1140M. A set of three cores shall be taken not less than once each shift that shotcrete is placed nor less than once for each 50 cubic yards of shotcrete placed through the nozzle. The diameter of core specimens shall be determined in accordance with ASTM C42/C42M.

3.6.2 Aggregate Moisture

Prior to batching the shotcrete and at least once during a shift in which shotcrete is being batched, the coarse and fine aggregate moisture content shall be determined in accordance with ASTM C566. The batch weights of both the aggregates and mixing water shall be appropriately adjusted to account for the available free moisture in the aggregates. The amount of free moisture in the aggregates, expressed as pounds of water per cubic yard, shall be recorded on the batching ticket and delivered to the Contracting Officer prior to placement during the shift. The Contracting Officer will have the option to request additional aggregate moisture content tests for each of the required tests.

3.6.3 Grading

The grading of the coarse and fine aggregate shall be determined in accordance with ASTM C136. The fine and coarse aggregate grading shall be determined prior to batching the shotcrete and at least once during a shift in which shotcrete is being batched. The Contracting Officer will have the option to require one additional sieve analysis test for aggregate type.

3.6.4 Thickness

The minimum shotcrete thickness shall be as shown in the drawings. The unhardened shotcrete shall be checked for thickness using a probe by the nozzleman or laborer at the time of placement. These thickness checks shall be at 15-minute intervals and all low or thin areas shall be corrected by applying additional shotcrete.

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3.6.5 Mixture Proportions

Record and check mixture proportions at least once per shift for weigh batching. Record and check mixture proportions as recommended by ASTM C685/C685M at least once per shift for volumetric batching and continuous mixing plants.

3.6.6 Preparations

Prior to each placement of shotcrete, the Contractor's inspector shall certify in writing or by an approved checkout form that cleanup and preparations are in accordance with the plans and specifications.

3.6.7 Air Content

Air content tests shall be conducted on wet-mix shotcrete according to ASTM C231/C231M with a frequency of not less than once each shift nor less than once for each 50 cubic yards of shotcrete placed through the nozzle. Tests shall be conducted on samples taken as the wet shotcrete mixture is placed in the delivery equipment.

-- End of Section --

SECTION 03 60 00

GROUTING
11/07

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 143/C 143M	(2010) Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 404	(2007) Standard Specification for Aggregate for Masonry Grout
ASTM C 595	(2010) Standard Specification for Blended Hydraulic Cement
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 1157	(2010) Standard Performance for Hydraulic Cement
ASTM C 1019	(2009) Standard Test Method for Sampling and Testing Grout
ASTM C 150	(2009) Standard Specification for Portland Cement
ASTM C 476	(2009) Standard Specification for Grout for Masonry
ASTM C 494/C 494M	(2010) Standard Specification for Chemical Admixtures for Concrete
ASTM C 94/C 94M Concrete	(2007) Standard Specification for Ready-Mixed Concrete

NATIONAL CONCRETE MASONRY ASSOCIATION (NCMA)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that

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will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Cold Weather Installation

Cold weather construction procedures.

Manufacturer's data sheets on each product to be used; G

Mixing and preparation instructions and recommendations.
Storage and handling requirements and recommendations
Installation methods

SD-06 Test Reports

Cementitious components of the grout mix

Grout

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

SD-07 Certificates

Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid compromising packages and contact with soil or contaminating material.

1.3.1 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in sealed, unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.4 QUALITY ASSURANCE

1.4.1 Spare Vibrator

Maintain at least one spare vibrator on site at all times.

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PART 2 PRODUCTS

2.1 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, fine. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 11 inches as measured by ASTM C 143. Minimum grout strength shall be 3000 psi in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.1.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

2.1.2 Grout Mix

Factory blended hydraulic cement based product containing aggregate and portland cement, blended cement, or a mixture of portland cement and fly ash proportioned to produce grout complying with ASTM C 476 for the specified type of grout; packaged course and fine fill grout.

1. Portland Cement or Blended Cement: ASTM C 150 Types I, IA, II, IIA, III or IIIA.
2. Portland Cement or Blended Cement: ASTM C 595 Types IS, IS(MS), IS-A, IS-A(MS), IP, or IP-A.
3. Portland Cement or Blended Cement: ASTM C 1157 Types GU, HE, MS, or HS.
4. Fly Ash: ASTM C 618.
5. Aggregate: ASTM C 404.
6. Coarse Grout: Adjust aggregate proportions to provide evenly graded mix which will be easily pumped, with coarse aggregate content no greater than maximum specified in the proportion specifications of ASTM C 476.

2.1.3 Water

Clean and free from deleterious acids, alkalies, and organic matter.

2.2 MIXING

Mixing Procedure: Add factory pre-blended dry materials to water in mortar mixer and mix for at least 5 minutes.

Retempering: Do not retemper grout; discard grout that cannot be easily pumped or poured.

Cold Weather: Follow National Concrete Masonry Association

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recommendations for cold weather construction.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, verify the applicable conditions as set forth in ACI 530.1, inspection. The Contracting Officer will serve as inspector.

3.2 REBAR

See Section 03 20 01.00 10 Concrete Reinforcement for requirements.

3.3 PLACING GROUT

Bollards containing rebar shall be filled with grout. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient grout shall be provided to grout each bollard to the height shown on the drawings without cold joints.

3.3.1 Grouting Equipment

3.3.1.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of.

3.3.1.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.3.2 Grout Placement

Grout shall be placed using a grout pump to completely fill the grout space without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state.

3.4 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

3.4.1 Separate and Recycle Waste

Place materials defined as hazardous or toxic waste in designated containers. Fold up metal banding, flatten, and place in designated area for recycling. Collect wood packing shims and pallets and place in designated area. Use leftover mixed mortar as directed where lower strength

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mortar meets the requirements for bulk fill. Separate masonry waste and place in designated area for use as structural fill. Separate selected masonry waste and excess for landscape uses, either whole or crushed as ground cover.

3.5 TEST REPORTS

3.5.1 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 4000 psi at 28 days.

--End of Section--

Soil Cement

10/12

PART 1 GENERAL

1.1 Soil Cement

The work consists of furnishing, placing, compacting, and curing a mixture of soil material, Portland cement, and water. The mixture shall be uniformly mixed, blended, compacted, finished, and cured as specified. It shall conform to the lines, grades, thicknesses, and cross section(s) shown on the drawings.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 559	Standard Test Methods for Wetting and Drying Compacted Soil-Cement Mixtures
ASTM D 560	Standard Test Methods for Freezing and Thawing Compacted Soil-Cement Mixtures
ASTM D 1632	Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
ASTM D 1633	Standard Test Method for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 558	Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures
ASTM C 94	Standard Specification for Ready-Mixed Concrete
ASTM C 618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

1.3 Material

Soil material shall be obtained from the required excavations or designated borrow locations and shall meet the requirements outlined in this section.

Deleterious material, such as sod, brush, or roots, shall be separated from soil material during the selection, blending, and routing operations. Rock particles larger than 2 inches in any dimension shall be removed before mixing.

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Soil material, cement content, and moisture content other than those specified may be used as approved by the engineer. Proposed alternatives must meet one of the following requirements to be considered:

- a. If the soil material to be used has gradation and Atterberg limits similar to the soils specified, the same cement content and water content shall be used. The contractor shall provide gradation and Atterberg limit test data from a qualified soil testing laboratory verifying gradation and Atterberg limits.
- b. If the soil material does not have gradation and Atterberg limits similar to the soils specified, the contractor shall provide soil-cement, moisture-density relations data, Atterberg limits, gradation tests, and either durability or strength tests as specified in paragraph 1.13 from a qualified soil testing laboratory. The soil-cement mix ratio and water content shall also be provided by the laboratory. If durability is selected, the following durability tests shall be provided: ASTM D 559 and ASTM D 560. If strength is selected, use ASTM D 1632 for cylinder preparation and curing and provide ASTM D 1633 test results. The moisture-density relations are to be in accordance with ASTM D 558. The tests must indicate a soil-cement of a quality equal to or exceeding the quality specified.

Portland cement shall conform to the requirements of 03 30 00.00 10 Cast in Place Concrete, for the specified type. Mixing of different brands or types of cement is not permitted.

Portland cement shall be furnished in bags, barrels, or bulk. Bagged cement that is stored at the job site shall be used in the same order as the deliveries arrived on the site. Each shipment of bagged cement shall be handled and stored so that it may be readily distinguished from other shipments. Emptied cement bags shall be disposed of by the contractor at offsite locations selected by the contractor. Burning of emptied cement bags is permitted if identified on the burning permit as an allowable activity.

Water used in mixing or curing soil-cement shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances, and shall meet the requirements for water as specified in ASTM C 94.

Pozzolanic material, when used, shall comply with the requirements of ASTM C 618 Class C or F, Specifications for Fly Ash, and Raw or Calcined Natural Pozzolan.

Curing compounds, when used, shall conform to the requirements set forth in 03 30 00.00 10 Cast in Place Concrete. Application of the curing compound shall be in accordance with paragraph 1.12 of this specification and the manufacturer's recommendations.

1.4 Operations Of Pits Or Stockpiles Of Soil Material

All work required in the opening and operation of borrow areas or

stockpiles shall be performed by the contractor. The borrow areas or stockpiles shall be opened in a manner to expose a near vertical face of the soil material for a suitable working depth. Exposed cut faces shall not exceed 5 feet in height without benching back if it poses a threat to construction personnel or others. The contractor shall conform to OSHA Construction Industry Standards (29 CFR Part 1926) Subpart P, Excavations, Trenching, and Shoring, during all excavation operations.

Material shall be excavated in successive vertical cuts extending across the pit or stockpile. When approved by the engineer, successive horizontal cuts on a horizontal oriented working face may be permitted in homogeneous soils. All pockets or strata of unsuitable material not meeting the quality requirements specified in paragraph 1.3 Material, shall be wasted. The method of operating the pit or stockpile and the blending of material shall be adjusted as necessary to obtain material conforming to the specifications. Upon completion of the work, the pits shall be graded and dressed to minimize erosion and to provide free drainage.

1.5 Foundation Preparation

Before soil-cement processing commences, the subgrade placement area shall be graded, shaped, and compacted in conformance with the lines and grades shown on the drawings. The subgrade shall firmly support the construction equipment. Immediately before placement of the soil-cement, the compacted subgrade surface shall be moistened to approximately the same moisture content as specified for the soil-cement, and shall be kept moist until the soil-cement is placed.

1.6 Design Of Soil-Cement Mixture

The materials and proportions of the soil-cement mixture shall constitute the job-mix. After a job-mix has been approved, the source, character, or grading of the soil and the type, brand, or quantity of cement or pozzolanic material shall not be changed without prior approval of the engineer. A change in material or proportions requires the establishment of a new job-mix supported by evidence, as required for the initial job-mix, that the proposed new material and mix proportions will produce soil-cement of the strength specified.

The use of calcium chloride or other accelerants or antifreeze compounds is not permitted unless approved by the engineer.

Method 1-The contractor shall determine the mix proportions and submit the job-mix design along with the supporting test results to the engineer for approval before incorporating any of the material into the work. The brand of cement and the location of the soil material source shall be included with the job-mix design data. The mix design shall be such that the soil-cement meets or exceeds the minimum compressive strength specified. A new mix design shall be submitted for approval any time the contractor requests a change in material or a proportioning of material from that given in the approved mix design. In no case will the engineer's review and approval of a mix design relieve the contractor of responsibility to provide soil-cement meeting the contract specifications.

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A maximum of 15 percent of the total weight of cement may be replaced with fly ash at a rate of 1.2 pounds of fly ash per pound of cement replaced.

Method 2—The contractor shall furnish the soil, fly ash, cement, and moisture content as specified in paragraph 1.13 of this specification. During the course of the work, the engineer may adjust the job-mix proportions as needed to achieve the specified compressive strength.

All methods—The percent of cement to be used in the mix is determined by dividing the weight of cement by the oven-dry weight of the soil material.

1.6 Mixing

The mixing plant shall produce a mixture of soil, cement, and water that is uniform in color and at the required moisture and cement content throughout. The plant shall be equipped with measurement devices that proportion the mix in the specified quantities. Before all measurement devices are used, they shall be calibrated and certified by a qualified technician approved by the engineer. The actual quantities of the mix shall not vary more than 2 percent from the approved job-mix quantities unless otherwise approved. The moisture content shall be the percent- age of moisture in the mixture at the time of compaction.

The engineer shall have full and free access to the mixing plant at all times for inspection of the plant's operation and for sampling the soil-cement mixture and its components.

Method 1—Mixing of the soil, cement (including fly ash), and water shall be accomplished in a stationary mixing plant. The plant may be either a batch type or a continuous flow type design. The plant may use either weight or volume proportioning. The scale or metering devices shall be sensitive to 1 percent of the maximum load that may be required or imposed. The mixer shall be a pugmill, revolving-blade, or rotary-drum system.

Facilities for efficiently storing, handling, and proportioning unmixed materials shall be provided at the plant.

Method 2—Mixing of the soil, cement (including fly ash), and water shall be accomplished in a truck mixer. The mixer shall meet the requirements for truck mixers contained in ASTM C 94.

Method 3—Mixing of the soil-cement shall be accomplished in place. Mixing of the soil, cement (including fly ash), and water shall be accomplished by a single or multiple transverse shaft mixer, a traveling pugmill, or similar equipment approved by the engineer. A motor grader or similar equipment is not acceptable in lieu of the mixing equipment specified.

Soil material to be mixed in place shall be formed into windrows or divided into known grid areas. If windrows are used, they shall be prepared to a known size with a sizing device. The tops of the windrows

shall be flattened or slightly trenched to receive the cement.

The cement quantity necessary to meet the specified cement-to-soil ratio shall be distributed uniformly on the windrowed soil or over the prepared grid areas. After spreading, cement that has been displaced or is found to be less than that specified shall be properly adjusted or replaced before starting mixing operations.

The mixing operation shall be accomplished so that no unmixed seams of soil are between layers. Excessive streaking of the soil cement below the layer being mixed is not allowed.

All methods—The following provisions apply to all methods of mixing. The mixing time shall be controlled so that all ingredients are mixed as long as necessary to ensure a thorough, uniform, homogeneous mixture of soil, cement, pozzolanic material (if used), and water. Mixing time shall be adjusted based on tests and field determinations. Mixing time is considered as the interval between the time the cement contacts the soil and water and the time the mixture leaves the mixing unit or when the mixer speed is reduced to the agitating speed. The soil and cement shall be mixed sufficiently to prevent cement balls from forming before the water is added. The water may be applied through the mixing machine or separately by approved pressure distributing equipment.

Soil that has plastic silt or clay lumps larger than 1 inch shall be pulverized or screened out of the raw soil before mixing.

1.7 Transporting

The soil-cement mixture shall be transported from the mixing plant to the site of placement in vehicles having tight, clean, smooth beds or mixer trucks. Haul time shall not exceed 30 minutes.

The contractor shall protect the soil-cement mixture if transported during unfavorable weather. Any material excessively wet by precipitation is subject to rejection.

Equipment shall not be operated on a finished and compacted layer of soil-cement except where specifically permitted. Any damage resulting to the finished surface of the soil-cement from such an operation shall be repaired by the contractor at no cost to the owner.

Earth ramps crossing over completed soil-cement must have a minimum compacted thickness of 2 feet. Where ramps are constructed over soil-cement that is not to finished grade, all foreign material and the uppermost inch of the top layer of soil-cement must be removed before the soil-cement installation is continued.

1.8 Placement

Soil-cement shall not be placed until the required excavations and preparation of the foundation are completed and the foundation has been inspected and approved by the engineer.

Equipment for spreading the soil-cement mixture shall be suitable for the purpose and shall be operated to produce a reasonably smooth, uniform

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surface. The equipment shall be controllable so as to produce uniform layers not more than the specified maximum thickness. The layer of soil-cement, or each successive lift when layering is required, shall be spread and compacted as soon as possible after the preceding layer is completed and approved. Soil-cement shall be placed in horizontal layers or layers conforming to the plane of the subgrade.

When the time between completion of compaction on a layer and start of placement of the next layer is more than 2 hours, the contractor shall scarify the surface to a depth of 1 inch at a maximum spacing of 12 inches unless specified otherwise in paragraph 1.13 or approved by the engineer. The contractor shall clean off the scarified surface thoroughly by power brooming or other approved methods before proceeding. The entire broomed surface shall then be thoroughly moistened before the next layer of soil-cement is placed.

Soil-cement placement operations may commence when the air temperature is not less 40 degrees Fahrenheit and a rising temperature is expected for the work period. Soil-cement shall not be placed on a frozen foundation or if the soil to be processed is frozen or if weather conditions are such that the material being processed cannot be completely compacted and protected before the onset of damaging weather (overnight lows below 40 degrees Fahrenheit, cold fronts, and rainstorms). The use of accelerators or antifreeze compounds is not allowed unless otherwise specified. The temperature of fresh soil-cement shall not be allowed to drop below 32 degrees Fahrenheit for 7 days after placement. If temperatures are expected to be below 45 degrees Fahrenheit, the contractor's method for protection shall be approved by the engineer before placement of any soil-cement.

When the mean air temperature does not exceed 90 degrees Fahrenheit, the moisture content at the time of compaction shall be within the range specified. When the mean air temperature exceeds 90 degrees Fahrenheit or conditions promoting rapid drying of the soil-cement mixture exist, the moisture content of the mixture may be increased up to 2 percentage points above optimum unless otherwise specified. Any increase in moisture content shall be less than the quantity that causes the soil cement to become unstable during the compaction and finishing operations.

1.9 Compaction

Equipment-Compaction equipment used shall be capable of uniformly compacting the soil-cement mixture to the specified density. It shall not have tamping feet or projections that penetrate to previously compacted layers. Compaction with only the wheels of the hauling equipment is not an acceptable method of compaction.

Compaction requirements-Soil-cement shall be uniformly compacted to a density not less than the minimum density specified. Optimum moisture and maximum density shall be determined by ASTM D 558. Natural Resources Conservation Service Test No. S-6 (USBR Test E-25), Rapid Compaction Control Method as referenced in NEH-19, may be used as equivalent to ASTM D 558.

Compaction shall start as soon as possible after spreading. Elapsed time between the addition of water to the soil-cement mixture and the start

of compaction shall not exceed 60 minutes. The elapsed time between addition of water to the soil-cement mixture and completion of compaction shall not exceed 90 minutes.

Other requirements—If the surface of a layer of soil-cement has been rutted or compacted unduly by hauling or other equipment, the contractor shall scarify and re-compact such surfaces within 2 hours of the addition of water to the cement. When required to maintain uniformity of the layer surface, blading in connection with compaction operations shall be employed. If blading is required, raw unmixed soil shall not be bladed onto the mixed soil- cement. When more than 2 hours has occurred from the time water was added to the cement, the damaged soil- cement shall be removed in a manner and to the extent approved by the engineer.

1.10 Construction Joints

At the end of each workday, or when the adjacent placing operation is terminated for more than 2 hours, a vertical construction joint shall be made along all unfinished edges of the thoroughly compacted soil-cement. Just before placing operations are resumed, the construction joint shall be shaved to remove all dry soil-cement and all curing compound from the joint face.

1.11 Removal and Replacement

The soil-cement installation shall be considered defective and shall be removed and replaced in accordance with these specifications when any one of the following conditions occur:

- a. Compaction operations are interrupted for any reason before the completion of compaction and the soil- cement mixture is left undisturbed for more than 30 minutes.
- b. The soil-cement mixture becomes excessively wet before completion of compaction so that the moisture content exceeds the specified limits.
- c. The compacted soil-cement does not meet the density and moisture requirements except that when the moisture is lower than required, the soil-cement mixture may be reworked, thoroughly mixed, and compacted within the time limits stated in paragraph 1.8, Compaction requirements.
 - The finished surface is rough or below grade such that a thin "scab" section would be required to smooth the surface or bring the surface to grade.

1.12 Protecting And Curing

1.12.1 Moistening bonding surface

Compacted surface of soil-cement that is to receive an overlay of soil-cement or concrete shall be kept moist until placement of the overlay or adjacent layer of soil-cement or concrete. The contractor is not required to keep such surfaces moistened for longer than 7 days unless the overlay of soil-cement or concrete is not accomplished within 7 days as a result of the contractor's

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operations.

1.12.2 Curing Finished Exposed Surface

Method 1—Concrete curing compound conforming to ASTM C 309 of the type specified shall be applied at a rate of not less than 1 gallon per 150 square feet of surface using constantly agitating, pressure spray equipment. This compound shall form a uniform, continuous, adherent film that does not check, crack, or peel.

The surface of each section of soil-cement to be treated with curing compound shall be moistened with a light spray of water immediately after the section has been compacted. As soon as the surface film of moisture disappears, but while the surface still has a damp appearance, the curing compound shall be applied. Special care shall be implemented to ensure ample coverage with the compound at edges, corners, and around rough spots. After application of the curing compound has been completed and the coating is dry to the touch, any required repair of the soil-cement surface shall be performed. To ensure a clean bonding surface, all curing compound or other foreign substances shall be removed from the area before additional soil-cement is applied. Each repair, after being finished, shall be moistened and coated with curing compound in accordance with the foregoing requirements.

Method 2—Curing moisture shall be maintained by sprinkling, flooding, fog spraying, or covering with continuously moistened canvas, cloth mats, straw, sand, or other approved material. Water or covering, or both, shall be applied so that the soil-cement surface is not eroded or otherwise damaged.

Method 3—Waterproof paper or plastic sheeting shall be used to completely cover the soil-cement and prevent moisture loss. Adjoining sheeting shall be overlapped at least 1 foot and weighted or taped to prevent moisture loss at joints. Sheeting shall be anchored sufficiently to prevent displacement by the wind.

All methods—The curing process shall be maintained for 7 days. Any curing compound that is removed from the surface or damaged within 7 days after application shall be repaired immediately. The contractor shall have all equipment and material required for curing at the site ready for use before starting soil-cement placement activities.

1.13 Inspection and Testing

During the course of the work, the engineer will perform quality assurance tests as required to identify materials and determine compaction characteristics, moisture content, and density of soil-cement in place. Tests performed by the engineer will be used to verify that the soil-cement placed conforms to contract requirements of the specifications and not as a replacement for the contractor's quality control program.

The contractor shall conduct all required quality control tests in accordance with the approved Contractor Quality Control Plan to assure that work performed meets contract requirements.

-- End of Section --

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SECTION 05 05 23

WELDING, STRUCTURAL
11/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (2006) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2007) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS A3.0 (2001; Errata 2001) Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermal Spraying

AWS D1.1/D1.1M (2008; Errata 2009) Structural Welding Code - Steel

AWS D1.3/D1.3M (2008; Errata 2008) Structural Welding Code - Sheet Steel

AWS D1.4/D1.4M (2005; Errata 2005) Structural Welding Code - Reinforcing Steel

AWS D14.1/D14.1M (2005) Welding Industrial and Mill Cranes and Other Material Handling Equipment

AWS D14.4/D14.4M (2005) Welded Joints for Machinery and Equipment

AWS Z49.1 (2005) Safety in Welding, Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E 165 (2009) Standard Test Method for Liquid Penetrant Examination

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ASTM E 709

(2008) Standard Guide for Magnetic Particle
Examination

1.2 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0. The following classifications Class 1 (highest class) to Class 6 (lowest class) indicate the project's class(es) of weld joints.

1.2.1 Class 1 Weld Joints

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (dynamic and cyclic loading) and characterized as a single point of failure with no redundancy for the redistribution of stress into another member.

1.2.2 Class 2 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

1.2.3 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.4 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.5 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

1.2.6 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 GENERAL REQUIREMENTS

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been

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qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.3.2 Mock-up Model

Perform first the field-welded connection designated as the mock-up model on the drawings. All welders qualified and designated to perform field-welded groove joints must be present during the welding of the mock-up model connections and each one shall perform a part of the welding. Simulate with the mock-up test all physical and environmental conditions that will be encountered during the welding of all groove joints. Execute all inspection procedures required for groove welded joints, including NDE tests, on the mock-up model. All Contractor inspection and testing personnel designated to perform QC of groove welded joints must be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection represents the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

- Welding Procedure Qualifications; G
- Welder, Welding Operator, and Tacker Qualification
- Inspector Qualification
- Previous Qualifications
- Pre-qualified Procedures

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

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SD-06 Test Reports

Quality Control
Nondestructive Examination

A quality assurance plan and records of tests and inspections. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

SD-07 Certificates

Certified Welding Procedure Specifications (WPS)
Certified Brazing Procedure Specifications (BPS)
Certified Procedure Qualification Records (PQR)
Certified Welder Performance Qualifications (WPQ)
Certified Brazer Performance Qualifications (BPQ)

Certificates in accordance with paragraph "Other Applications".

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualification to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

The organization performing this work must be certified in the following: American Institute of Steel Construction (AISC) Quality Certification Program Category I Conventional Steel Structures.

a. For Structural Projects, provide documentation of the following:

- 1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.
- 2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3.
- 3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

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1) Submit for review to the Contracting Officer two copies of Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) within fifteen calendar days after receipt of Notice to Proceed.

2) Cranes: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.1/D14.1M.

3) Submit for review to the Contracting Officer two copies of Certified Welder Performance Qualifications (WPQ) and Certified Brazer Performance Qualifications (BPQ) within fifteen calendar days prior to any employee welding on the project material.

4) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.5.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.5.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, the procedure specification must be revised and re-qualified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, must be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract must be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

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1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification must state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

1.6.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.
- d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific

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reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications must be in accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing personnel in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols must be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safe welding practices and safety precautions during welding must conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes must be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2 Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

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3.2 QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual and ultrasonic or radiographic inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E 165, ASTM E 709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable.

3.3 STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection and magnetic particle testing methods. The minimum extent of nondestructive testing shall be random 5-10 percent of welds or joints or every 500 linear feet of fence fabrication, whichever is greater.

3.3.1 Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M

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and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201-06	(2006) AISC Certification Program for Structural Steel Fabricators
AISC 317	(1992; Reprint 1999) ASD Manual of Steel Construction, Vol II: Connections
AISC 325	(2011) Manual of Steel Construction
AISC 326	(2009) Detailing for Steel Construction
AISC 360	(2010) Specification for Structural Steel Buildings, with Commentary
AISC 201 Structural Steel Fabricators	(2006) AISC Certification Program for

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	(2008; Errata 2009) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 143/A 143M	(2007) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 490	(2010) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 500	(2010) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53/A 53M	(2010) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 780	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 992/A 992M	(2011) Standard Specification for Structural Steel Shapes
ASTM F 844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F2453	Standard Specification for Welded Wire mesh Fence Fabric (Metallic-Coated or Polymer Coated) for Meshes of 6 in. ² or Less, in Panels or Rolls, with Uniform Meshes

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(2007) Commercial Blast Cleaning
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1.2 SYSTEM DESCRIPTION

Provide the structural steel for fencing system and any required shop primed or galvanized steel, complete and ready for use. Structural steel works shall include specified design, materials, installation, workmanship, fabrication, assembly, inspection, quality control, and testing in accordance with AISC 316 and AISC 317 except as modified in this contract.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports; G

Fabrication drawings including description of connections; G

SD-03 Product Data

Welding electrodes and rods

SD-06 Test Reports

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Welding procedures and qualifications

1.4 AISC QUALITY CERTIFICATION

Not Applicable.

1.5 SEISMIC PROVISIONS

Not Applicable.

1.6 QUALITY ASSURANCE

1.6.1 Fabrication and Erection Quality Control Procedures

Quality control procedures for the fabrication and erection of all fence panels and components shall be included in the Contractor quality control plan. Quality control procedures shall be reviewed and approved by Contracting Officer's Representative (COR) prior to start of fabrication.

1.6.2 Shop Drawing Requirements

As applicable, submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 325, AISC 326, and AISC 317. Fabrication drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

Provide connection, forming and stiffening details for Structural Steel. Avoid ledges, crevices and pockets that hold water, water-laden debris or condensation.

1.6.2 Certifications

1.6.2.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.6.2.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 HSS Bollards

ASTM A500 Grade B, Structural Steel, rectangular, tabular steel, sizes as shown on drawings.

2.1.3 HSS Rails

ASTM A500 Grade B, Structural Steel, Rectangular, tabular steel, HSS, sizes as shown on the drawings.

2.1.4 WF Columns, Beams, and Rail

ASTM A992 Grade 50, Structural Steel, Structural wide flange sizes as shown on the drawings.

2.1.5 HSS Post and Beam

ASTM A500 Grade B, Structural Steel, Structural posts and beams, HSS, sizes as shown on the drawings.

2.1.6 Plates, Bars and Angles

ASTM A36, Structural Steel, Structural sizes as shown on the drawings.

2.1.7 Sheet

ASTM A1011, Grade 36, Steel, Sheet and Strip, Carbon, Hot-Rolled for Sheathing and Miscellaneous Brackets.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel

2.2.1.1 Bolts

ASTM A 325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A 563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307, ASTM A 325 and ASTM A 490 bolts.

2.4 STRUCTURAL STEEL ACCESSORIES

2.4.1 Welding Electrodes and Rods

AWS D1.1/D1.1M. Use low-hydrogen electrodes as specified by the American Welding Society for welding Weathering Steel. Suggestions on minimum preheat are contained in the latest revisions of ANSI/AWS "Structural Welding Code" 01.1 and the ANSI/AASHTO/AWS "Bridge Welding Code" 01.5.

When matching strength is required, and color match and corrosion resistance are not important, E70, E80, E90, E100 or E110 low-hydrogen electrodes may be used. These electrodes also work for the underlying passes in multiple-pass welds.

2.5 SHOP PRIMER

Not used.

2.6 GALVANIZING

Connection elements (bolts, connection brackets, etc) shall be galvanized in accordance with ASTM A 153/A 153M.

2.7 FABRICATION

2.7.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

2.7.2 Cleaning

SSPC SP 6, Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.8 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 316.

Splices not indicated require the approval of the Contracting Officer.

3.2 ERECTION

Erection of structural steel shall be in accordance with the applicable provisions of AISC 316 or endorsement F of AISC FCD. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A 325 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.4 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the COR.

3.5 WELDING

AWS D1.1, except as follows.

Use only shielded metal arc welding and low hydrogen electrodes for ASTM A 514 steel. Do not stress relieve ASTM A 514 steel by heat treatment.

Conform to suggestions on minimum preheat that are contained in the latest revisions of ANSI/AWS "Structural Welding Code" 01.1 and the ANSI/AASHTO/AWS "Bridge Welding Code" 01.5. When matching strength is required, and color match and corrosion resistance are not important, E70, E80, E90, E100 or E110 low-hydrogen electrodes may be used. These electrodes also work for the underlying passes in multiple-pass welds. However, when color match and corrosion resistance are important, appropriate alloy electrodes must be used for the final two exposed top layers. Welding shall be consistent with AWS recommended procedures including adequate edge preparation and preheating, the selection of proper flux (when applicable) and the use of properly dried, low-hydrogen electrodes and fluxes.

Grind exposed welds smooth as indicated. Provide AWS D1.1 qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.5.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.6 SHOP PRIMER REPAIR

Not used.

3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The COR shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.8.1 Welds

3.8.1.1 Visual Inspection

AWS D1.1. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.8.1.2 Nondestructive Testing

AWS D1.1. Test locations shall be as indicated. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the COR. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used. Retest defective areas after repair.

Testing frequency: Provide for 5-10 percent of welds or joints, or every 500 linear feet of fence fabrication, whichever is greater. Testing frequency will be increased if visual inspections reveal that welds are suspect.

Nondestructive testing shall be performed by AWS-certified inspectors only.

3.8.2 Testing for Embrittlement

ASTM A 143 for steel products hot-dip galvanized after fabrication.

-- End of Section -

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SECTION 31 00 00

EARTHWORK
08/08

PART 1 GENERAL

1.1 PAYMENT PROCEDURES

Earthwork will not be paid as a separate line item. The contractor shall include earthwork costs in the appropriate line item on the Price Schedule.

Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

1.1.1 Authorized Overhaul

The number of station-yards of overhaul to be paid for will be the product of number of cubic yards of overhaul material measured in the original position, multiplied by the overhaul distance measured in stations of 100 feet.

1.2 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.
- c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- d. Material character is indicated by the boring logs.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180 (2010) Standard Method of Test for
Moisture-Density Relations of Soils Using
a 4.54-kg (10-lb) Rammer and a 457-mm
(18-in.) Drop

AASHTO T 224 (2010) Standard Method of Test for
Correction for Coarse Particles in the
Soil Compaction Test

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ASTM INTERNATIONAL (ASTM)

ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1140	(2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1557	(2009) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 1883	(2007e2) CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2434	(1968; R 2006) Permeability of Granular Soils (Constant Head)
ASTM D 2487	(2011) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	(1963; R 2007) Particle-Size Analysis of Soils
ASTM D 4318	(2010) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 698	(2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual
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U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.4 DEFINITIONS

1.4.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as

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GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, ML, CL-ML. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements and railroads which comprise stones less than 3 inches in any dimension.

1.4.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C136, ASTM D 422, and ASTM D 1140.

1.4.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with AASHTO T 224. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.4.5 Topsoil

Material suitable for topsoils obtained from excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.4.6 Hard/Unyielding Materials

Hard/Unyielding materials comprise weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" dimension as defined by the pipe manufacturer. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.4.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted

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pneumatic hole punchers or rock breakers. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.4.8 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.4.9 Select Granular Material

1.4.9.1 General Requirements

Select granular material consist of materials classified as GW, by ASTM D 2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index must not be greater than 15 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D 1140. Provide a minimum coefficient of permeability of 0.002 feet per minute when tested in accordance with ASTM D 2434.

1.4.9.2 California Bearing Ratio Values

Bearing Ratio: At 0.1 inch penetration, provide a bearing ratio of 20 percent at 95 percent ASTM D 1557 maximum density as determined in accordance with ASTM D 1883 for a laboratory soaking period of not less than 4 days. Conform the combined material to the following sieve analysis:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inches	100
No. 3/4 inches	80 - 100
No. 3/8 inches	60 - 80
No. 4	40 - 60
No. 8	28 - 48
No. 16	20 - 36
No. 30	14 - 26
No. 50	10 - 22
No. 100	9 - 17
No. 200	8 - 15

1.4.10 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks 3 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 3 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.4.11 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 15 when tested in accordance with ASTM D 4318.

1.5 SYSTEM DESCRIPTION

Subsurface soil boring logs are located in the geotechnical report. These

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data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.5.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation. Finish the specified excavation on a classified basis, in accordance with the following designations and classifications.

1.5.2 Blasting

Perform blasting in accordance with EM 385-1-1 and in conformance with Federal, State, and local safety regulations. Submit notice 15 days prior to starting work. Submit a Blasting Plan, prepared and sealed by a registered professional engineer that includes calculations for overpressure and debris hazard. Provide blasting mats and use the non-electric blasting caps. Obtain written approval prior to performing any blasting and notify the Contracting Officer 24 hours prior to blasting. Include provisions for storing, handling and transporting explosives as well as for the blasting operations in the plan. The Contractor is responsible for damage caused by blasting operations.

1.5.3 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring; G
Dewatering Work Plan; G
Blasting; G

Submit 15 days prior to starting work.

SD-03 Product Data

Utilization of Excavated Materials; G
Rock Excavation
Opening of any Excavation or Borrow Pit
Shoulder Construction

Procedure and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing

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Borrow Site Testing

Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates

Testing

Qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Within 24 hours of conclusion of physical tests, submit 2 copies of test results, including calibration curves and results of calibration tests. Do not bring material onsite until tests have been approved by the Contracting Officer.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

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2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 MATERIAL FOR RIP-RAP

Provide Bedding material, Filter fabric and rock conforming to these requirements for construction indicated.

2.4.1 Bedding Material

Provide bedding material consisting of sand, gravel, or crushed rock, well graded, or poorly graded with a maximum particle size of 2 inches. Compose material of tough, durable particles. Allow fines passing the No. 200 standard sieve with a plasticity index less than six.

2.4.2 Rock

Provide rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Use rock fragments free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. Provide fragments sized so that no individual fragment exceeds a weight of 150 pounds and that no more than 10 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Provide rock with a minimum specific gravity of 2.50. Do not permit the inclusion of more than trace 1 percent quantities of dirt, sand, clay, and rock fines.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Stockpile in locations indicated or Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport

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satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on Drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

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3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction.

3.2.5 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D 698 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas within the limits of the project site, selected by the Contractor. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS

Notify the Contracting Officer sufficiently in advance of the opening of any excavation or borrow pit or borrow areas to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace

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such material with satisfactory material from approved sources.

3.6 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. For pile foundations, stop the excavation at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.7 GROUND SURFACE PREPARATION

3.7.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.7.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3.8 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted, in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

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3.9 BURIED TAPE AND DETECTION WIRE

3.9.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.9.2 Buried Detection Wire



3.10 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.11.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 18 inches of cover in rock excavation and a minimum 24 inch of cover in other excavation.

3.11.2 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.11.3 Rip-Rap Construction

Construct rip-rap on filter fabric in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.11.3.1 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire

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mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above. For grouted rip-rap, hand-place surface rock with open joints to facilitate grouting and do not fill smaller spaces between surface rock with finer material. Provide at least one "weep hole" through grouted rip-rap for every 50 square feet of finished surface. Provide weep holes with columns of bedding material, 4 inches in diameter, extending up to the rip-rap surface without grout.

3.12 EMBANKMENTS

3.12.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.13 SUBGRADE PREPARATION

3.13.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. Operate the roller truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material as directed by the Contracting Officer and replace with select material.

3.13.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of (b) (5) below finished grade for the subgrade. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade

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more than 0.05 foot from the established grade and cross section.

3.13.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 95 percent of laboratory maximum density.

3.13.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top of subgrade.

3.13.3.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percentage laboratory maximum density for the full depth of the shoulder.

3.14 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified.. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the Contracting Officer has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.15 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.15.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not

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permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.15.2 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.16 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly to a thickness of 1 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

3.17 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with ASTM D 6938. ASTM D 6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D 6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.17.1 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

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3.17.2 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 5 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.17.3 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

-- End of Section --

SECTION 31 63 29

DRILLED CONCRETE PIERS AND SHAFTS

05/09

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117	(2010) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	(2010) Specifications for Structural Concrete
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2010) Specification for Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2011) Building Code Requirements for Structural Concrete and Commentary
ACI 336.1	(2001) Specification for the Construction of Drilled Piers
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10	(2010; Change 2010; Change 2011) Minimum Design Loads for Buildings and Other Structures
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AMERICAN WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2004) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2010) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2009b) Standard Specification for
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	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A82/A82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C143/C143M	(2010) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2011) Standard Specification for Portland Cement
ASTM C172	(2010) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C31/C31M	(2010) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2010) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94/C94M	(2011a) Standard Specification for Ready-Mixed Concrete

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2009; 28th Ed) Manual of Standard Practice
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U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA IF-99-025	(2000) Drilled Shafts: Construction Procedures and Design Methods (with Errata Sheet)
FHWA IP-84-11	(1984) Handbook on Design and Construction of Drilled Shafts Under Lateral Load

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.501	Duty to Have Fall Protection
29 CFR 1926.502	Fall Protection Systems Criteria and Practices
29 CFR 1926.651	Specific Excavation Requirements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation drawings are to include, but not limited to, the following items indicating a completely dimensioned layout and

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location of drilled shafts and concrete placement for foundation system:

Drilled shaft diameters
Depth of test holes
Top and Bottom of shaft elevations
Steel Reinforcement
Anchor bolt locations
Accessories

SD-05 Design Data

As applicable submit the following:

Applicable Building code criteria for the geographic area where the excavation will take place
Casing description

Submit Mix design data in accordance with the paragraph entitled, "Ready-Mix Concrete".

SD-06 Test Reports

Submit test reports in accordance with the test described in paragraph entitled, "Field Testing" for the following items:

Soils Report
Ground Water conditions
Load Test
Penetration Test
Slump
Concrete
Compressive Strength

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Bill of Lading for "Ready-Mix Concrete" deliveries
Steel Reinforcement
Welding Certificates
Excavation and Drilling Equipment

Qualifications of Excavator
Certify that the excavator meets requirements specified under paragraph entitled "Qualifications of Excavation Contractor".

Qualifications of Engineer
Certify that the engineer meets requirements specified under paragraph entitled "Qualifications of Professional Engineer".

1.3 QUALITY ASSURANCE

1.3.1 General

Install Drilled Shaft Foundations in accordance with applicable requirements as described by ACI 336.1 "Reinforced Specifications for the Construction of Drilled Piers", ADSC "Standards and Specifications for the

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Foundation Drilling Industry", FHWA IF-99-025 "Drilled Shafts: Construction Procedures and Design Methods" and FHWA IP-84-11 "Handbook on Design and Construction of Drilled Shafts under Lateral Load".

Submit design data for the following:

- a. Drilled shaft foundation design analysis to include, but not limited to the following:
 - (1) Casing description
- b. Mix design data in accordance with the paragraph entitled, "Ready-Mix Concrete", accompanied by the Bill of Lading for Ready Mix Concrete deliveries.

1.3.2 Sequencing and Scheduling

Submit a detailed installation plan describing the schedule for drilling and/or excavation, installation of steel reinforcement and concrete placement with anticipated site conditions so that each excavated shaft is poured the same day that the drilling is performed.

Submit detailed shop drawings for the following:

- a. Drilled shaft diameters
- b. Depth of test holes
- c. Top and Bottom of shaft elevations
- d. Steel Reinforcement
- e. Anchor bolt locations
- f. Accessories

1.3.3 Drilling and Excavation Equipment

Provide drilling and excavation equipment having adequate capacity, including but not limited to, power, torque and down thrust to excavate a hole of diameter and depth indicated. Also provide excavation and over-reaming tools of adequate design, size and strength to perform the work indicated.

Provide special drilling equipment including, but not limited to, rock core barrels, rock tools, air tools and other equipment as necessary to construct the shaft excavation to the size and depth indicated when materials encountered can not be drilled using earth augers and/or over-reaming tools.

Submit certificates substantiating appropriate selection of excavation and drilling equipment.

1.3.4 Construction Criteria

Provide and install monolithically cast-in-place concrete drilled shaft foundation to the sizes indicated.

Provide and install straight cylindrical shaft foundation of the type

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indicated.

Tolerances:

- a. Maximum variation of the center of any shaft foundation from the required location: 3 inches, measured at the ground surface.
- b. Bottom Diameter: Minus zero, plus 6 inches, measured in any direction.
- c. Maximum variation from plumb: 1:40.
- d. Maximum bottom level: Plus or minus 2 inches.

1.3.5 Inspection Criteria

Inspection activities should be designed to minimize delays while insuring the intent of the Industry Standard Specifications.

Provide equipment for checking the dimensions and alignment of each shaft excavation. Determine dimensions and alignment jointly with the contractor and engineer. Measure final shaft depths with appropriate weighted tape measure or other approved method after cleaning.

A minimum of 50 percent of the base for each shaft is to be less than 1/2 inch of sediment at the time of concrete placement. Maximum depth of sediment or debris at any place on the base of the shaft is not to exceed 1-1/2 inches. Shaft cleanliness is to be determined by the engineer by visual inspection.

1.3.6 Qualification of Excavation Contractor

An experienced excavator with five (5) years experience and licensed in the State of Arizona who has specialized in excavating and installing work similar in material, design, and extent to that indicated for this Project. Submit certificates substantiating the Qualifications of Excavator.

1.3.7 Qualification of Professional Engineer

Provide engineering services by an authorized engineer; currently licensed in the State of Arizona, having a minimum of four (4) years experience as an engineer knowledgeable in drilled shaft foundation design analysis, protocols and procedures for the ACI 336.1, FHWA IF-99-025, FHWA IP-84-11; ASCE 7-10 and the 2012 International Building Code. Submit certificates substantiating the Qualifications of Engineer.

1.3.8 Welding Qualifications

Provide and maintain qualified procedures and personnel according to AWS D1.1/D1.1M, AWS D1.4/D1.4M, AWS A5.1/A5.1M "Carbon Steel Electrodes for Shielded Metal Arc Welding", and "Structural Welding Code--Steel". Submit Welding Certificates. Submit Welding Certificates to the Contracting Officer.

1.3.9 Pre-Construction Conference

After submittals are received and approved but before drilled shaft excavation and foundation work, including associated work, is performed, the Contracting Officer will hold a pre-construction conference to review the following:

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- a. The drawings, specifications and the geotechnical report.
- b. Finalize construction schedule and verify availability of materials, Excavator's personnel, equipment, and facilities needed to make progress and avoid delays.
- c. Methods and procedures related to drilled shaft foundation installation, including engineer's written instructions.
- d. Support conditions for compliance with requirements, including alignment between foundation system and erection of structural members.
- e. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.
- f. Temporary protection requirements for foundation assembly during and after installation.

1.4 PROJECT CONDITIONS

1.4.1 Existing Conditions

Locate existing underground utilities before excavating drilled shaft foundations. If existing utilities are to remain in place, provide protection during drilled shaft operations.

1.4.2 Interruption of Existing Utilities

Do not interrupt any utility to occupied facilities unless directed in writing by the Contracting Officer.

1.4.3 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into the area of excavation.

PART 2 PRODUCTS

2.1 STEEL REINFORCEMENT

2.1.1 Deformed Steel Bars

Steel bars conforming to ASTM A615/A615M, Grade 60 ksi and ACI 318.

2.1.2 Plain Steel Wire

Steel wire conforming to ASTM A82/A82M.

2.2 READY-MIX CONCRETE

Ready-Mix Concrete and Mix Design conforming to ACI 117, ACI 301, and ACI 304R, minimum compressive strength 4,000 psi at 28 days. Slump to be between 5 to 6 inches, according to ASTM C143/C143M.

Portland cements conforming to ASTM C150/C150M, Type II; provide one brand and type of cement for formed concrete having exposed to view finished surfaces.

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Potable water conforming to ASTM C94/C94M.

Measure, batch, mix and deliver concrete according to ASTM C94/C94M and furnish batch ticket information.

PART 3 EXECUTION

3.1 PREPARATION

Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled shaft foundation operations.

Provide Fall Protection as required by 29 CFR 1926.501, 29 CFR 1926.502 and 29 CFR 1926.651.

3.2 REQUIRED TEST REPORTS

As a minimum, submit the following test reports and data.

Ground Water conditions

- b. Load Test
- c. Penetration Test
- d. Slump
- e. Concrete
- f. Compressive Strength

3.3 EXCAVATION

Excavation of shaft foundations to be accomplished by standard excavation methods including, but not limited to, conventional augers fitted with soil and/or rock teeth, or under-reaming tools attached to drilling equipment of adequate size, power, torque and down thrust necessary for the work.

Excavation is to be performed through whatever materials that are encountered to the dimensions, depths and applicable ACI 336.1 tolerances.

Protect excavated walls with temporary watertight steel casings of sufficient length to prevent water intrusion, cave-ins, displacement of surrounding earth, and injury to personnel and damage to construction operations.

Excavate shafts for drilled foundations to indicated elevations. Remove loose debris, materials and/or muck to make bottom surfaces level within ACI 336.1 tolerances.

Remove water from excavated shaft prior to concrete placement.

3.4 STEEL REINFORCEMENT

Comply with recommendations in the CRSI "Manual of Standard Practice" CRSI 10MSP for fabricating, placing and supporting reinforcement. Shop fabricate steel reinforcement in accordance with ACI SP-66.

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When practicable to deliver the reinforcement cage assembly to the jobsite as a complete unit ready for installation, should it not be possible make remaining connections and/or splices, as indicated on the approved shop drawings, at-grade level prior to lowering the complete assembly into the hole.

Clean reinforcement of loose rust, mill scale, earth and other foreign materials. Do not tack weld crossing reinforcing bars. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Lower reinforcement steel into the hole in such a manner as to prevent damage to the walls of the excavation; place, tie and/or clip cage symmetrically about the axis of the shaft. Use centering devices securely attached to the cage; to clear the shaft walls and to maintain the cage in place throughout the concrete placement operations.

Cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between reinforcing and embedded items, notify the Contracting Officer that conflicts may be reconciled before concrete placement. Anchors and embedded items are to be positioned and supported with appropriate accessories.

Use templates to set anchor bolts, leveling plates and other accessories required for structure erection. Provide blocking and/or holding devices to maintain required anchoring positions during final concrete placement.

3.5 CONCRETE PLACEMENT

Keep all equipment, including but not limited to, mixers, pumps, hoses, tools and screeds clean and free or set concrete throughout the placement operation.

Convey concrete from the mixer to place of deposit by best industry methods that will prevent segregation and loss of material. Size and design the equipment for conveying concrete to ensure uniform, continuous placement of concrete.

Place concrete in accordance with ACI 318.

Place concrete in a continuous operation and without segregation into dry excavations whenever possible after inspection and written approval by the Contracting Officer. Use all practicable means to obtain a dry excavation before and during concrete placement.

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. When hot weather conditions exist that would impair quality and strength of placed concrete, comply with ACI 305R. Comply with ACI 306.1 for cold-weather protection.

3.6 FIELD TESTING

Sample and test concrete for quality control during placement. Quality control testing is provided by the contract.

Sample freshly placed concrete for testing in accordance with ASTM C172.

Test concrete for compressive strength at 7 and 28 days for each design mix conforming to ASTM C39/C39M and compression testing in accordance with

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ASTM C31/C31M.

Test Slump at plant for reach design mix in accordance with ASTM C143/C143M.

-- End of Section --

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PRE-MANUFACTURED RETAINING WALL SYSTEM
10/12

PART 1 GENERAL

1.1 Pre-Manufactured Retaining Wall System

Work includes furnishing and installing concrete retaining wall units to the lines and grades designated on the construction drawings and as specified herein.

1.2 Reference Standards

ASTM INTERNATIONAL (ASTM)

ASTM C94 Ready-Mixed Concrete

ASTM C1372 Segmental Retaining Wall Units

ASTM C 94 Standard Specification for Ready-Mixed Concrete

1.3 Delivery, Storage, and Handling

- a. Contractor shall check the materials upon delivery to assure proper material has been received.
- b. Contractor shall prevent excessive mud, wet cement and like materials from coming in contact with the SRW units.
- c. Contractor shall protect the materials from damage. Damaged material shall not be incorporated in the project.

PART 2: MATERIALS

2.1 Wall Units

- a. Wall units shall be as produced by a licensed manufacturer.
- b. Wall units shall be made with Ready-Mixed concrete in accordance with ASTM C94, latest revision, and per the following chart:

Climate	Air Content	28 Day Compressive Strength, psi	Slump*
Negligible	1½%-4½%	4000	5" ±1 ½"
Moderate	3%-6%	4000	5" ±1 ½"
Severe	4½%-7½%	4000	5" ±1 ½"

*Higher slumps are allowed if achieved by use of appropriate admixtures. Notwithstanding anything stated above, all material used in the wall units must meet applicable ASTM and local requirements for exterior concrete.

- c. Exterior block dimensions shall be uniform and consistent. Maximum dimensional deviations shall be 1%. Maximum width (face to back) deviation shall be 1.0 inch.
- d. Exposed face shall be smooth form type. Dime-size bug holes on the block face may be patched and/or shake-on color stain can be used to blend into the remainder of the block face.

2.2 Leveling Pad and Free Draining Backfill

- a. Leveling pad shall be crushed stone. See detail sheet defining Leveling Pad options for drain placement in the bottom of the foundation leveling pad.
- b. Free Draining Backfill material shall be washed stone and shall be placed to a minimum of 1' width behind the back of the wall and shall extend vertically from the Leveling Pad to an elevation 4" below the top of wall.
- c. Backfill material shall be approved by the geotechnical engineer. Site excavated soils may be used if approved unless otherwise specified in the drawings. Unsuitable soils with a PL>6, organic soils and frost susceptible soils shall not be used within a 1 to 1 influence area.
- d. Non-woven geotextile cloth shall be placed between the Free Draining Backfill and retained soil if required.
- e. Where additional fill is needed, Contractor shall submit sample and specifications to the Engineer for approval.

2.3 Drainage

- a. Internal and external drainage shall be evaluated by the Professional Engineer who is responsible for the final wall design.

2.4 Geogrid Connection

- a. Fiberglass rod used in the Type 1AT Geo-Grid connection shall be 7/16" diameter. Only fiberglass rod obtained from an authorized pre-manufactured retaining wall supplier shall be used.

PART 3: CONSTRUCTION OF WALL SYSTEM

3.1 Excavation

- a. Contractor shall excavate to the lines and grades shown on the construction drawings.

3.2 Foundation Soil Preparation

- a. Native foundation soil shall be compacted to 95% of standard proctor or 90% of modified proctor prior to placement of the Leveling Pad material.
- b. In-situ foundation soil shall be examined by the Engineer to ensure that the actual foundation soil strength meets or exceeds assumed design strength. Soil not meeting the required strength shall be removed and replaced with acceptable, compacted material.

3.3 Leveling Pad Placement

- a. Leveling Pad shall be placed as shown on the construction drawings.
- b. Leveling Pad shall be placed on undisturbed native soils or suitable replacements fills.
- c. Leveling Pad shall be compacted to 95% of standard proctor or 90% of modified proctor to ensure a level, hard surface on which to place the first course blocks. Pad shall be constructed to the proper elevation to ensure the final elevation shown on the plans.
- d. Leveling Pad shall have a 6 inch minimum depth for walls under 8 feet in height and a 12 inch minimum depth for walls over 8 feet. Pad dimensions shall extend beyond the blocks in all directions to a distance at least equal to the depth of the pad or as designed by Engineer.
- e. For steps and pavers, a minimum of 1" - 1 ½" of free draining sand shall be screeded smooth to act as a placement bed for the steps or pavers.

3.4 Unit Installation

- a. The first course of wall units shall be placed on the prepared Leveling Pad with the aesthetic surface facing out and the front edges tight together. All units shall be checked for level and alignment as they are placed.
- b. Ensure that units are in full contact with Leveling Pad. Proper care shall be taken to develop straight lines and smooth curves on base course as per wall layout.
- c. The backfill in front and back of entire base row shall be placed and compacted to firmly lock them in place. Check all units again for level and alignment. All excess material shall be swept from top of units.
- d. Install next course of wall units on top of base row. Position blocks to be offset from seams of blocks below. Blocks shall be placed fully forward so knob and groove are engaged. Check each block for proper alignment and level. Backfill to 12 inch width behind block with Free Draining Backfill. Spread backfill in uniform lifts not exceeding 9 inches. Employ methods using lightweight compaction equipment that will not disrupt the stability or batter of the wall. Hand-operated plate compaction equipment shall be used around the block and within 3 feet of the wall to achieve consolidation. Compact backfill to 95% of standard proctor (ASTM D 698, AASHTO T-99) density within 2% of its optimum moisture content.
- e. Install each subsequent course in like manner. Repeat procedure to the extent of wall height.
- f. Allowable construction tolerance at the wall face is 2 degrees vertically and 1 inch in 10 feet horizontally.

- g. All walls shall be installed in accordance with local building codes and requirements.

3.5 Geogrid Installation

- a. See Wall Installation instructions.

-- End of Section --

APPENDIX D

GEOTECHNICAL TESTING RESULTS

(b) (7)(E)

PLATE A
VICINITY MAP
C-1 FENCE REPAIR
JOB NO. 12GC012



1851 West 24th Street P.O. Box 6029
DENVER, CO 80202 (303) 344-8374
Email: nea@neaw.com

BW23 FORM 001

(b) (7)(E)

THIS PROJECT

PLATE B
LOCATION MAP
C-1 FENCE REPAIR
JOB NO. 12GC012



1851 West 24th Street P.O. Box 6029
BIRMINGHAM, AL 35202-6029
Phone: (205) 344-8374
Email: ne@neicw.com

LEGEND



BORING LOCATION



PLATE C
BORING LOCATION MAP
C-1 FENCE REPAIR
JOB NO. 12GC012



1851 West 24th Street P.O. Box 6029
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BW23 FOIA CE 1004 11/20/2011



Nicklaus Engineering, Inc.
1851 W. 24th St.
Yuma, Arizona 85364
Telephone: 928-344-8374
Fax: 928-726-6994

BORING NUMBER BH-1

PAGE 1 OF 1

CLIENT Michael Baker, Jr., Inc.

PROJECT NAME C-1 Fence Repair

PROJECT NUMBER 12GC012

PROJECT LOCATION Winterhaven, CA

DATE STARTED 9/7/12

COMPLETED 9/7/12

GROUND ELEVATION

HOLE SIZE 8 inches

DRILLING CONTRACTOR NEI

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING 20.00 ft at time of drilling

LOGGED BY GCE

CHECKED BY (b) (6)

AT END OF DRILLING

NOTES Boring Location:

(b) (7)(E)

AFTER DRILLING

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						

(b) (7)(E), (b) (5)

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Nicklaus Engineering, Inc.
1851 W. 24th St.
Yuma, Arizona 85364
Telephone: 928-344-8374
Fax: 928-726-6994

BORING NUMBER BH-2

PAGE 1 OF 2

CLIENT Michael Baker, Jr., Inc.

PROJECT NAME C-1 Fence Repair

PROJECT NUMBER 12GC012

PROJECT LOCATION Winterhaven, CA

DATE STARTED 9/10/12

COMPLETED 9/10/12

GROUND ELEVATION _____

HOLE SIZE 6 inches

DRILLING CONTRACTOR Pacific Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

☒ AT TIME OF DRILLING 28.00 ft at time of drilling

LOGGED BY GCE

CHECKED BY (b) (6)

AT END OF DRILLING —

NOTES Boring Location: (b) (7)(E)

AFTER DRILLING —

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						

(b) (7)(E), (b) (5)

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BW23 FOIA CBP 004619



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BORING NUMBER BH-2

PAGE 2 OF 2

CLIENT Michael Baker, Jr., Inc.

PROJECT NAME C-1 Fence Repair

PROJECT NUMBER 12GC012

PROJECT LOCATION Winterhaven, CA

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
(b) (7)(E), (b) (5)						



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Telephone: 928-344-8374
Fax: 928-726-6994

BORING NUMBER BH-3

PAGE 1 OF 2

CLIENT Michael Baker, Jr., Inc.

PROJECT NAME C-1 Fence Repair

PROJECT NUMBER 12GC012

PROJECT LOCATION Winterhaven, CA

DATE STARTED 9/10/12

COMPLETED 9/10/12

GROUND ELEVATION

HOLE SIZE 6 inches

DRILLING CONTRACTOR Pacific Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING 28.00 ft at time of drilling

LOGGED BY GCE

CHECKED BY (b) (6)

AT END OF DRILLING

NOTES Boring Location: (b) (7)(E)

AFTER DRILLING

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						

(b) (7)(E), (b) (5)

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/26/12 15:03 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\12GC012 C-1 FENCE REPAIR.GPJ

(Continued Next Page)

BW23 FOIA CBP 004621



Nicklaus Engineering, Inc.
1851 W. 24th St.
Yuma, Arizona 85364
Telephone: 928-344-8374
Fax: 928-726-6994

BORING NUMBER BH-3

PAGE 2 OF 2

CLIENT Michael Baker, Jr., Inc.

PROJECT NAME C-1 Fence Repair

PROJECT NUMBER 12GC012

PROJECT LOCATION Winterhaven, CA

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
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(b) (7)(E), (b) (5)



Nicklaus Engineering, Inc.
1851 W. 24th St.
Yuma, Arizona 85364
Telephone: 928-344-8374
Fax: 928-726-6994

BORING NUMBER BH-4

PAGE 1 OF 2

CLIENT Michael Baker, Jr., Inc.

PROJECT NAME C-1 Fence Repair

PROJECT NUMBER 12GC012

PROJECT LOCATION Winterhaven, CA

DATE STARTED 9/10/12 COMPLETED 9/10/12

GROUND ELEVATION _____ HOLE SIZE 6 inches

DRILLING CONTRACTOR Pacific Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

✓ AT TIME OF DRILLING 20.00 ft at time of drilling

LOGGED BY GCE CHECKED BY (b) (6)

AT END OF DRILLING —

NOTES Boring Location: (b) (7)(E)

AFTER DRILLING —

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						

(b) (7)(E), (b) (5)

GENERAL BH / TP / WELL - GINT STD US LAB GDT - 8/26/12 15:03 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\12GC012 C-1 FENCE REPAIR.GPJ

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BW23 FOIA CBP 004623



Nicklaus Engineering, Inc.
1851 W. 24th St.
Yuma, Arizona 85364
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Fax: 928-726-6994

BORING NUMBER BH-4

PAGE 2 OF 2

CLIENT Michael Baker, Jr., Inc.

PROJECT NAME C-1 Fence Repair

PROJECT NUMBER 12GC012

PROJECT LOCATION Winterhaven, CA

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
(b) (7)(E), (b) (5)						

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/26/12 15:03 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\12GC012 C-1 FENCE REPAIR.GPJ

PRELIMINARY SCREENING FOR CORROSIVITY

Table of General Guidelines

MATERIAL AFFECTED	CHEMICAL AGENT	AMOUNT IN SOIL (PPM)	DEGREE OF CORROSIVITY
CONCRETE	Soluble Sulfates	0 - 1,000	Low
		1,000 - 2,000	Moderate
		2,000 - 20,000	Severe
		>20,000	Very Severe
MATERIAL AFFECTED	CHEMICAL AGENT	AMOUNT IN SOIL (PPM)	DEGREE OF CORROSIVITY
NORMAL GRADE STEEL	Soluble Chlorides	0 - 200	Low
		200 - 700	Moderate
		700 - 1,500	Severe
		>1,500	Very Severe
MATERIAL AFFECTED	CHEMICAL AGENT	AMOUNT IN SOIL (PPM)	DEGREE OF CORROSIVITY
NORMAL GRADE STEEL	Resistivity	1 - 1,000	Very Severe
		1,000 - 2,000	Severe
		2,000 - 10,000	Moderate
		>10,000	Low

Chemical Analysis

SITE DESIGNATION	pH	Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
C-1 Border Fence (Borehole #2)	9.34	2,200	80	188

LANDMARK CONSULTANTS, INC.

CLIENT: Gutierrez Canales Engineering

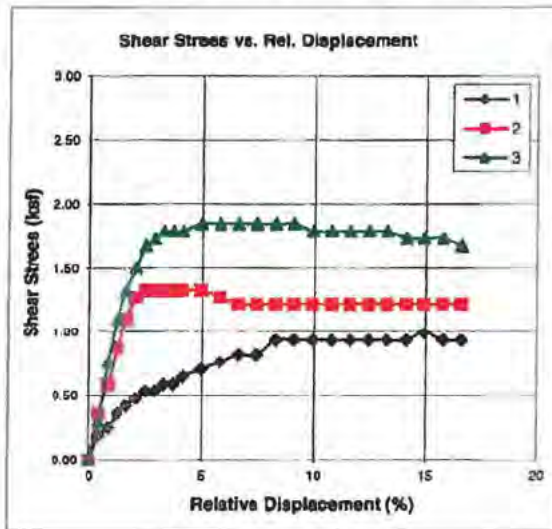
PROJECT: 2012 Material Testing

PROJECT No: LE12002

DATE: 9/14/2012

DIRECT SHEAR TEST - INSITU (ASTM D3080)

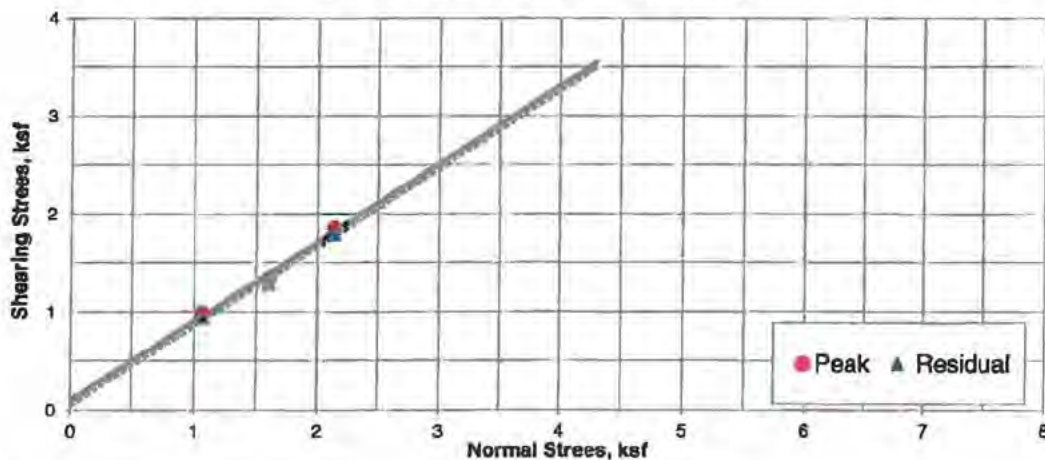
SAMPLE LOCATION: C-1-B @ 2.5-4.0 ft
 SAMPLE DESCRIPTION: Gravely Sand (SP)



Specimen:		1	2	3	Avg.
Initial	Moisture Content, %:	5.3	5.3	5.3	5.3
	Dry Density, pcf:	128.0	128.1	127.7	127.9
	Saturation, %:	48	48	48	
Final	Moisture Content, %:	15.7	14.0	15.2	
	Dry Density, pcf:	123.2	126.5	129.2	
	Saturation, %:	121	120	144	
Normal Stress, ksf:		1.07	1.61	2.15	
Peak Shear Stress, ksf:		0.99	1.33	1.85	
Residual Shear Stress, ksf:		0.93	1.28	1.79	
Deformation Rate, in./min.		0.01	0.01	0.01	

		Peak	Residual	
Angle of Internal Friction, deg.:		39	39	
Cohesion, ksf:		0.10	0.04	

DIRECT SHEAR TEST RESULTS



LANDMARK
 Geo-Engineers and Geologists
 PROJECT No: LE12002

Direct Shear
 Test Results

Plate
 C-1

LANDMARK CONSULTANTS, INC.

CLIENT: Gutierrez Canales Engineering

PROJECT: 2012 Material Testing

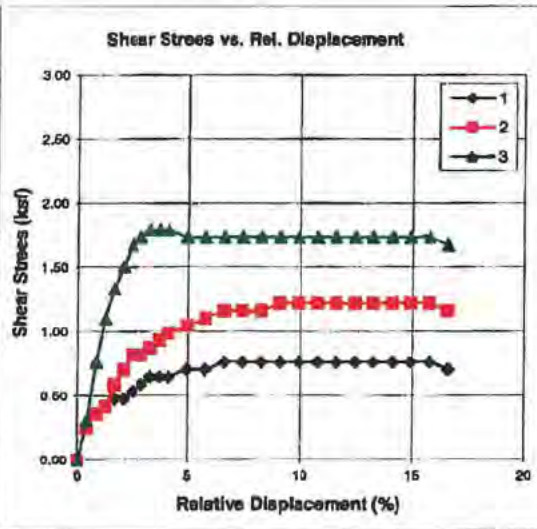
PROJECT No: LE12002

DATE: 9/14/2012

DIRECT SHEAR TEST - INSITU (ASTM D3080)

SAMPLE LOCATION: C-1-C @ 5-6.5 ft

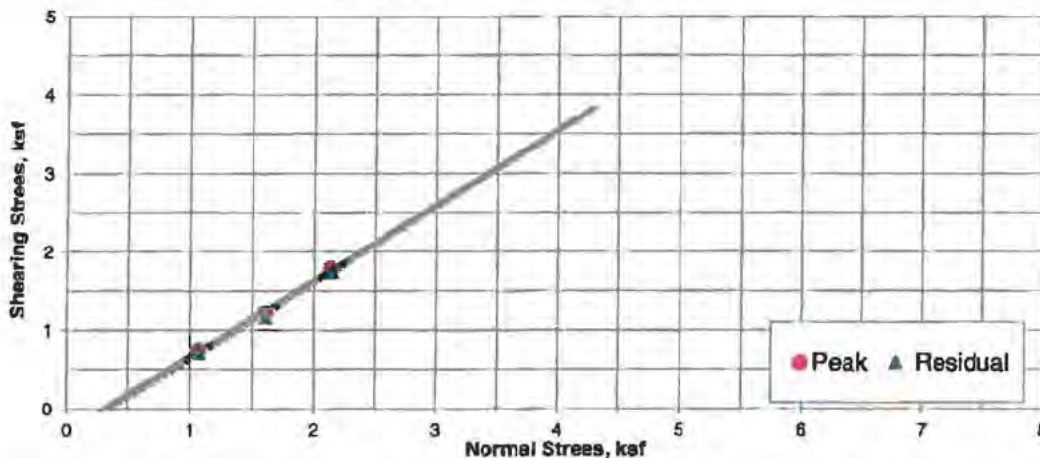
SAMPLE DESCRIPTION: Gravely Sand (SP)



Specimen:		1	2	3	Avg.
Initial	Moisture Content, %:	5.5	5.5	5.5	5.5
	Dry Density, pcf:	128.3	128.6	128.0	128.3
	Saturation, %:	50	51	50	
Final	Moisture Content, %:	15.7	15.5	14.8	
	Dry Density, pcf:	122.3	127.6	123.9	
	Saturation, %:	117	138	117	
Normal Stress, ksf:		1.07	1.61	2.15	
Peak Shear Stress, ksf:		0.76	1.22	1.79	
Residual Shear Stress, ksf:		0.7	1.16	1.74	
Deformation Rate, in./min.		0.01	0.01	0.01	

		Peak	Residual	
Angle of Internal Friction, deg.:		44	44	
Cohesion, ksf:		0.00	0.00	

DIRECT SHEAR TEST RESULTS



LANDMARK
Geo-Engineers and Geologists
PROJECT No: LE12002

Direct Shear
Test Results

Plate
C-2

C-1 Fence Repair
Michael Baker, Jr., Inc.

12GC012

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-02

PROCEDURE USED: C

September 20, 2012

PREPARATION METHOD: Moist

Boring #1; S-1 @ 1.0 - 3.0'

RAMMER TYPE: Mechanical

Brown Silty Gravel with Sand (GM)

SPECIFIC GRAVITY: 2.65 (assumed)

SIEVE DATA:

Sieve Size	% Retained
3/4"	12
3/8"	18
#4	21

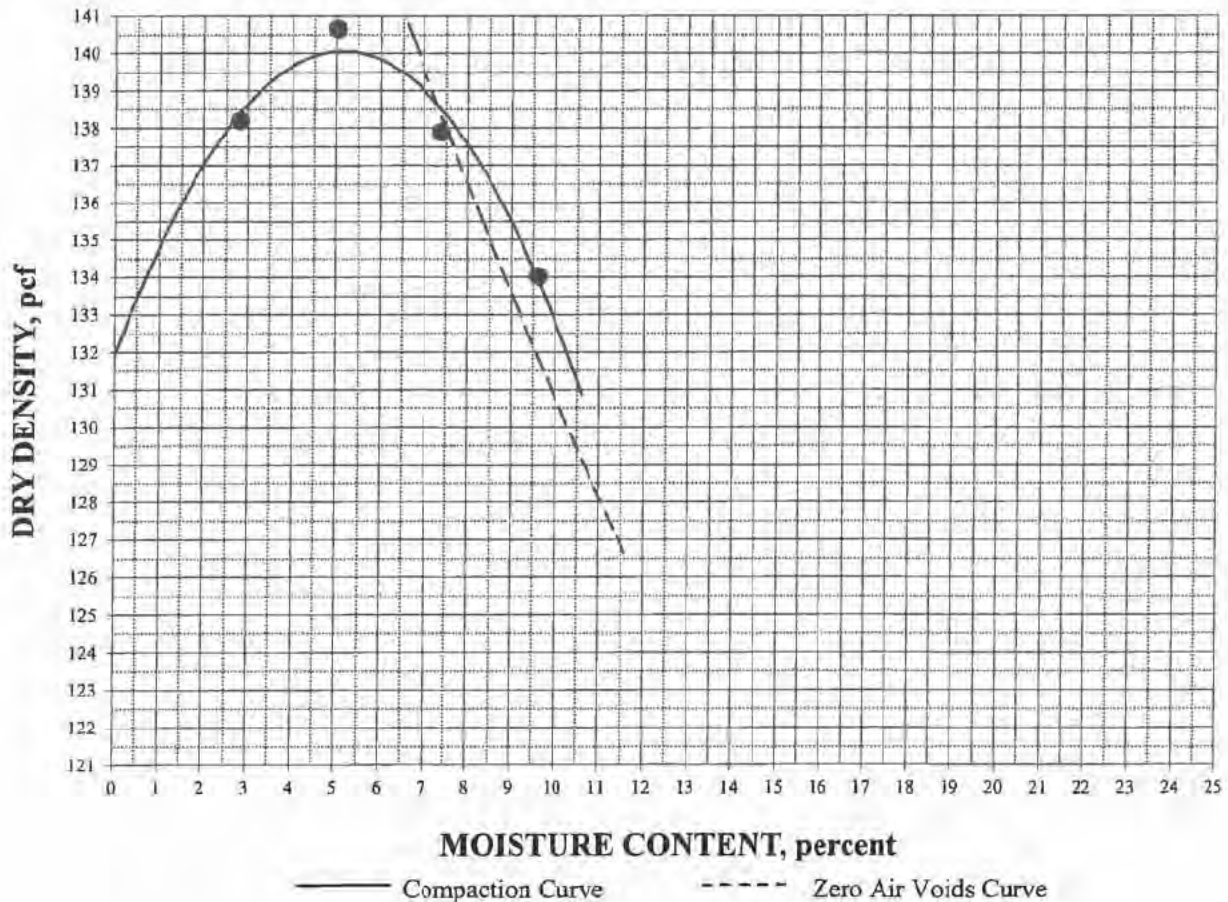
MAXIMUM DRY DENSITY: 140.0 pcf

OPTIMUM MOISTURE: 5.0%

OVERSIZE PARTICLE CORRECTION (ASTM D 4718)

CORRECTED MAXIMUM DENSITY: 142.0 pcf

CORRECTED OPTIMUM MOISTURE: 4.5 %



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #1; S-1 @ 0.0 - 1.0'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

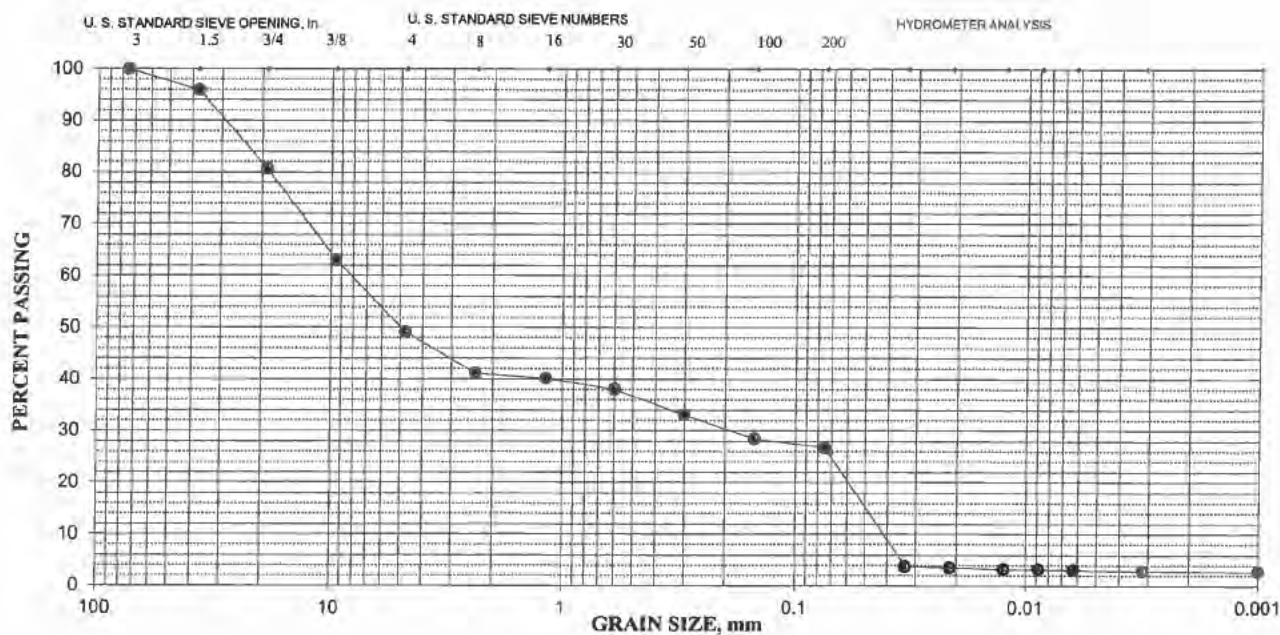
LL = 0; PL = 0; PI = 0

Gravel = 51%; Sand = 22%; Silt = 24%; Clay = 3%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	4	96
3/4" (19.0-mm)	19	81
3/8" (9.5-mm)	37	63
#4 (4.75-mm)	51	49
#8 (2.36-mm)	59	41
#16 (1.18-mm)	60	40
#30 (600-μm)	62	38
#50 (300-μm)	67	33
#100 (150-μm)	72	28
#200 (75-μm)	73	27

Hydrometer Analysis

33-μm	4
21-μm	4
12-μm	3
9-μm	3
6-μm	3
3.2-μm	3
Colloids (<1-μm)	3



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #1; S-2 @ 1.0 - 6.5'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

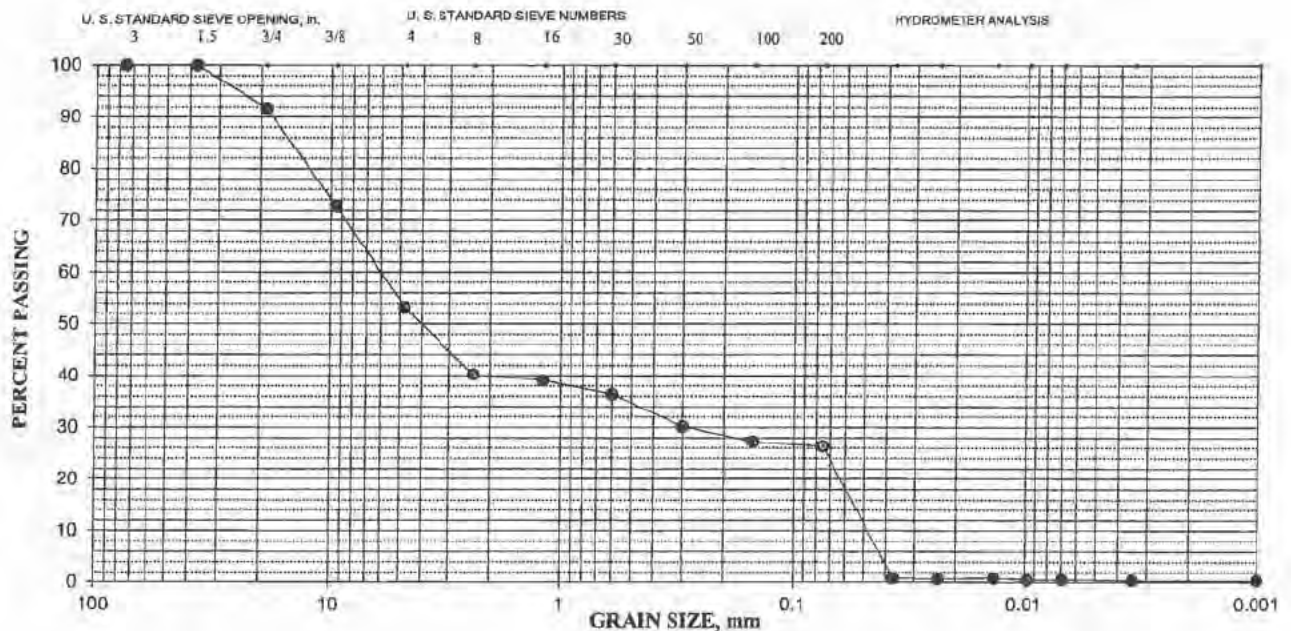
LL = 0; PL = 0; PI = 0

Gravel = 47%; Sand = 27%; Silt = 26%; Clay = 0%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	8	92
3/8" (9.5-mm)	27	73
#4 (4.75-mm)	47	53
#8 (2.36-mm)	60	40
#16 (1.18-mm)	61	39
#30 (600- μ m)	64	36
#50 (300- μ m)	70	30
#100 (150- μ m)	73	27
#200 (75- μ m)	74	26

Hydrometer Analysis

37- μ m	1
24- μ m	1
14- μ m	1
10- μ m	0
7- μ m	0
3.4- μ m	0
Colloids (<1- μ m)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #1; S-3 @ 6.5 - 11.5'

September 20, 2012

Light Brown Poorly Graded Sand with Silt (SP-SM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

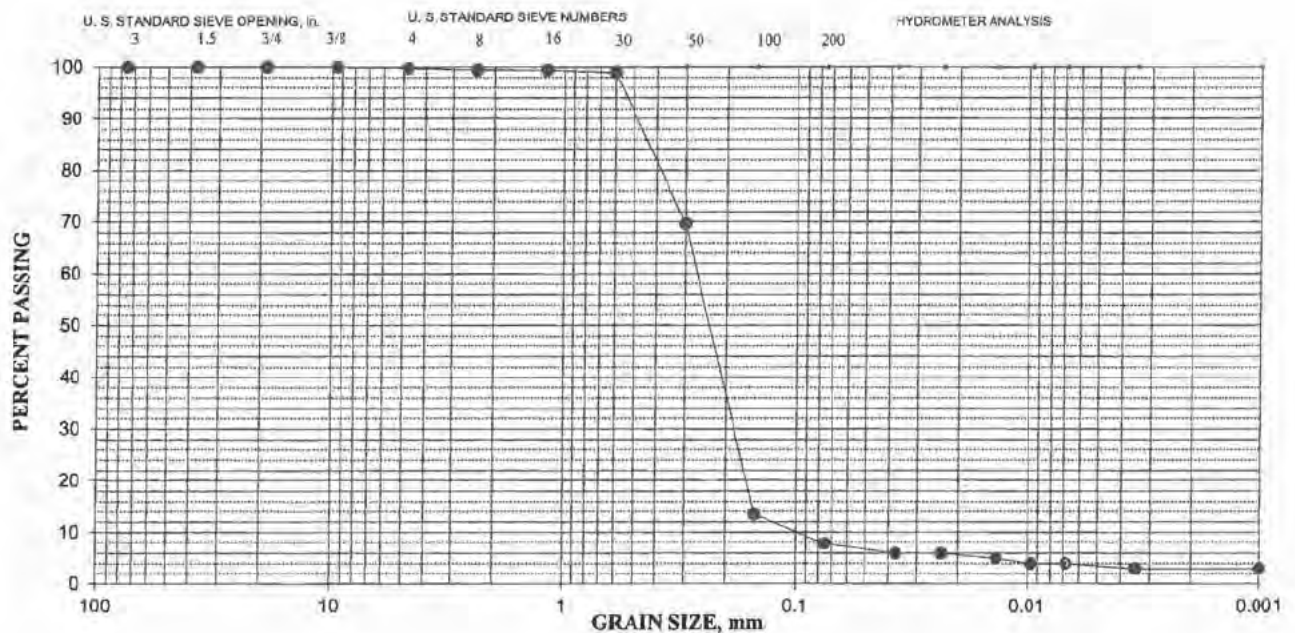
Gravel = 0%; Sand = 92%; Silt = 5%; Clay = 3%

Cu = 2.7; Cc = 1.3

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	0	100
#8 (2.36-mm)	1	99
#16 (1.18-mm)	1	99
#30 (600-μm)	1	99
#50 (300-μm)	30	70
#100 (150-μm)	87	13
#200 (75-μm)	92	8

Hydrometer Analysis

37-μm	6
23-μm	6
14-μm	5
10-μm	4
7-μm	4
3.4-μm	3
Colloids (<1-μm)	3



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #1; S-4 @ 11.5 - 16.5'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

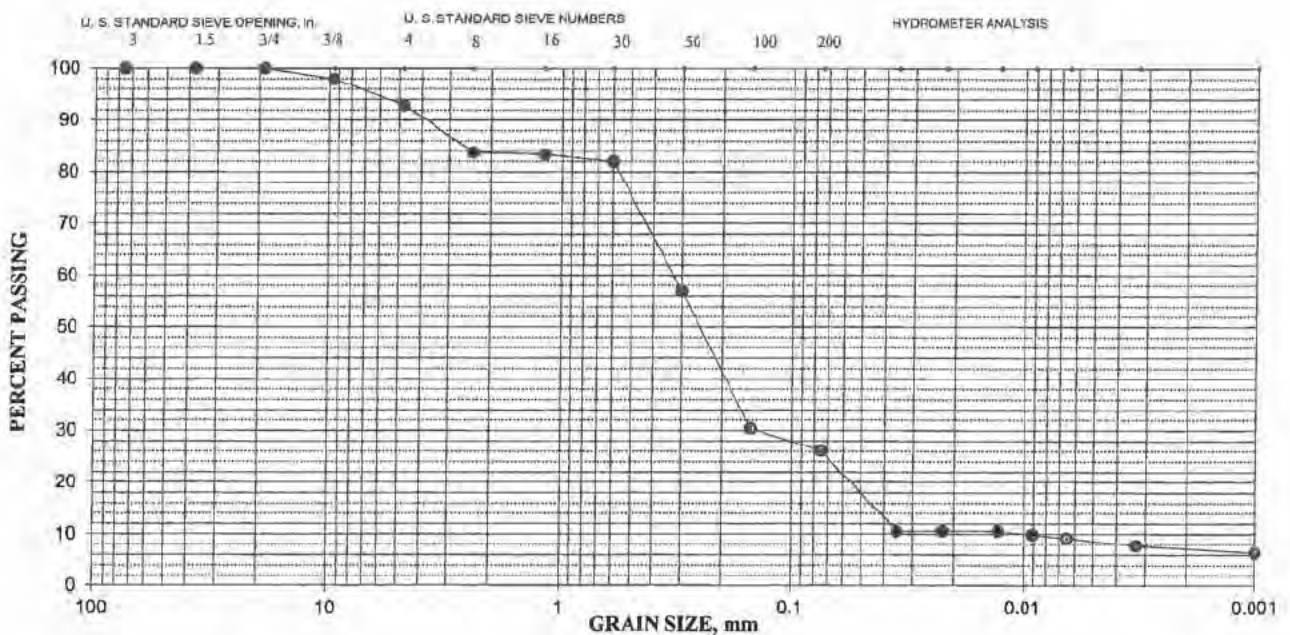
LL = 0; PL = 0; PI = 0

Gravel = 7%; Sand = 67%; Silt = 18%; Clay = 8%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	2	98
#4 (4.75-mm)	7	93
#8 (2.36-mm)	16	84
#16 (1.18-mm)	17	83
#30 (600-μm)	18	82
#50 (300-μm)	43	57
#100 (150-μm)	70	30
#200 (75-μm)	74	26

Hydrometer Analysis

35-μm	11
22-μm	11
13-μm	11
9-μm	10
6-μm	9
3.3-μm	8
Colloids (<1-μm)	6



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-6 @ 0.0 - 1.0'

September 20, 2012

Light Brown Silty Gravel (GM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

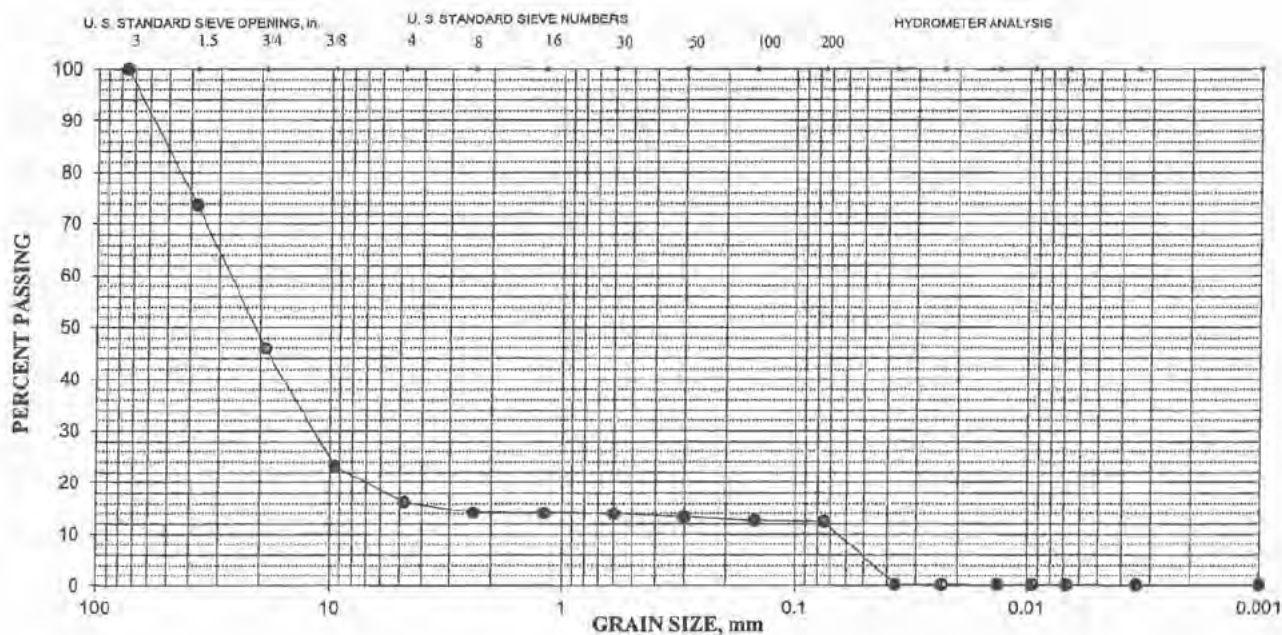
Gravel = 84%; Sand = 4%; Silt = 12%; Clay = 0%

Cu = 411.9; Cc = 78.6

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	26	74
3/4" (19.0-mm)	54	46
3/8" (9.5-mm)	77	23
#4 (4.75-mm)	84	16
#8 (2.36-mm)	86	14
#16 (1.18-mm)	86	14
#30 (600-μm)	86	14
#50 (300-μm)	87	13
#100 (150-μm)	87	13
#200 (75-μm)	88	12

Hydrometer Analysis

36-μm	0
23-μm	0
13-μm	0
9-μm	0
7-μm	0
3.4-μm	0
Colloids (<1-μm)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-7 @ 1.0 - 5.0'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

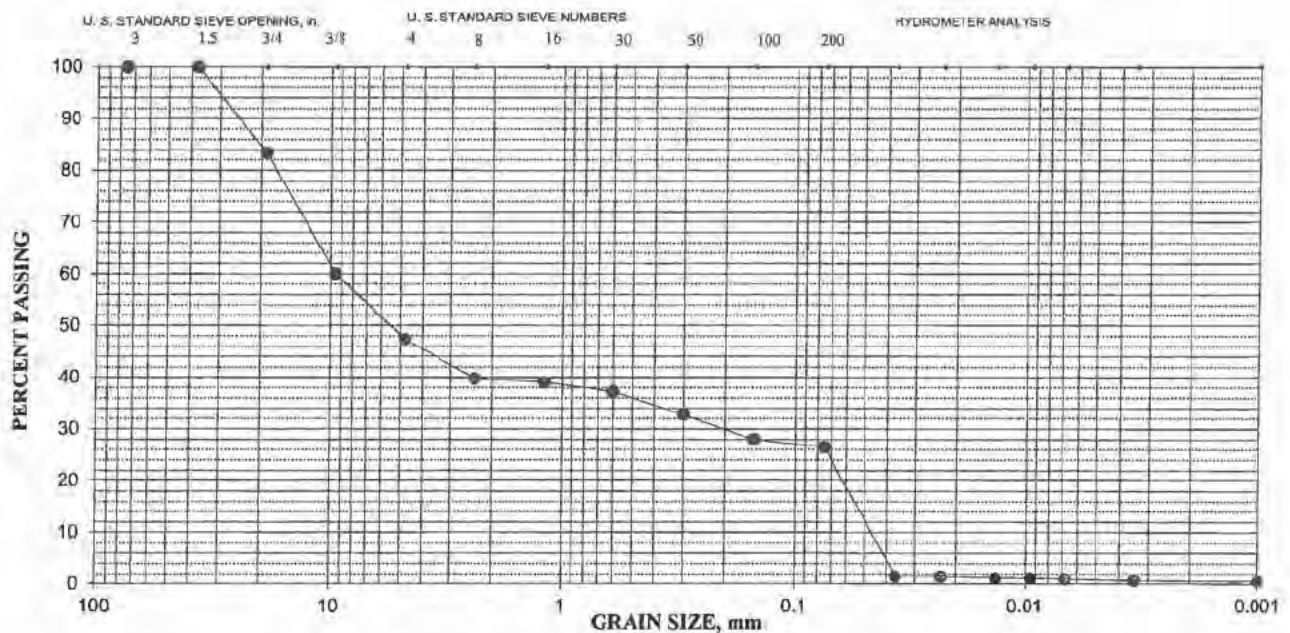
LL = 0; PL = 0; PI = 0

Gravel = 53%; Sand = 21%; Silt = 25%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	17	83
3/8" (9.5-mm)	40	60
#4 (4.75-mm)	53	47
#8 (2.36-mm)	60	40
#16 (1.18-mm)	61	39
#30 (600-μm)	63	37
#50 (300-μm)	67	33
#100 (150-μm)	72	28
#200 (75-μm)	74	26

Hydrometer Analysis

36-μm	1
23-μm	1
13-μm	1
9-μm	1
7-μm	1
3.4-μm	1
Colloids (<1-μm)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-8 @ 5.0 - 6.5'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

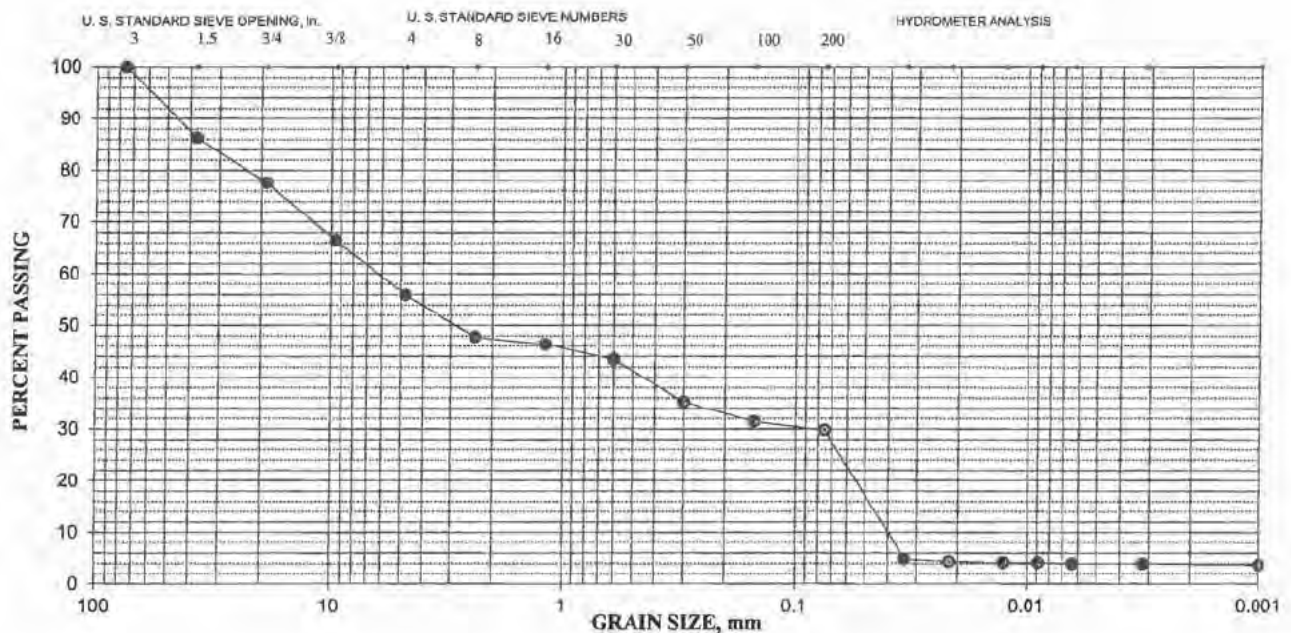
LL = 0; PL = 0; PI = 0

Gravel = 44%; Sand = 26%; Silt = 26%; Clay = 4%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	14	86
3/4" (19.0-mm)	22	78
3/8" (9.5-mm)	34	66
#4 (4.75-mm)	44	56
#8 (2.36-mm)	52	48
#16 (1.18-mm)	54	46
#30 (600-μm)	57	43
#50 (300-μm)	65	35
#100 (150-μm)	69	31
#200 (75-μm)	70	30

Hydrometer Analysis

34-μm	5
22-μm	4
13-μm	4
9-μm	4
6-μm	4
3.2-μm	4
Colloids (<1-μm)	4



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-9 @ 6.5 - 11.5'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

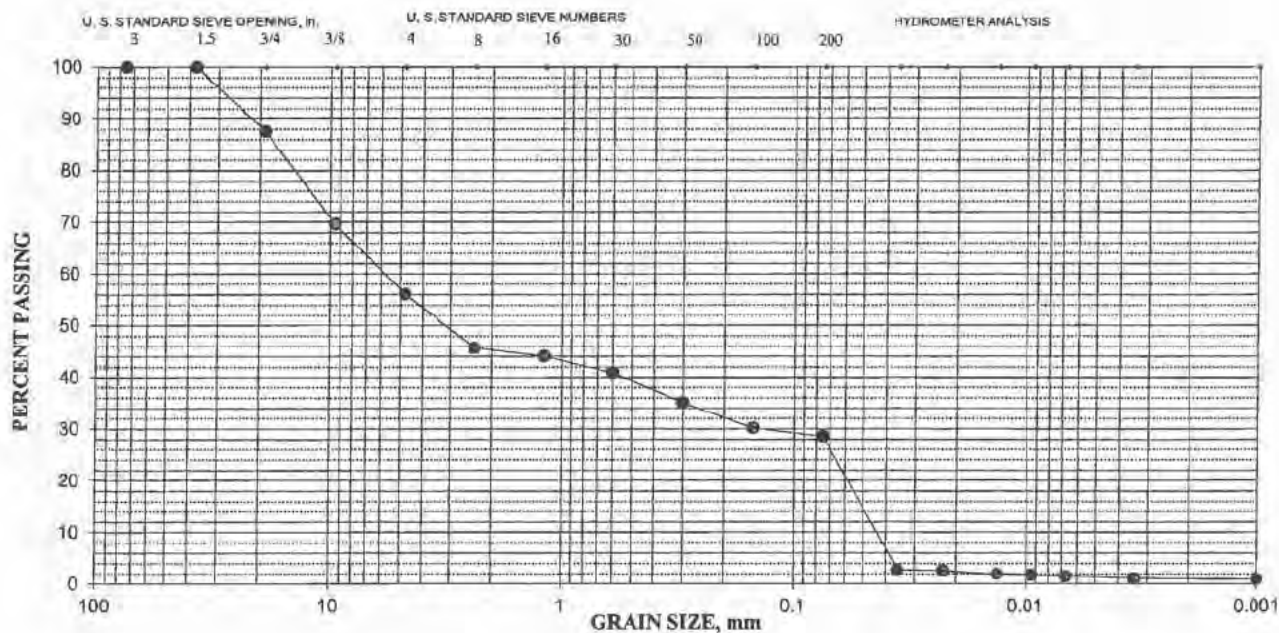
LL = 0; PL = 0; PI = 0

Gravel = 44%; Sand = 27%; Silt = 28%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	12	88
3/8" (9.5-mm)	30	70
#4 (4.75-mm)	44	56
#8 (2.36-mm)	54	46
#16 (1.18-mm)	56	44
#30 (600-μm)	59	41
#50 (300-μm)	65	35
#100 (150-μm)	70	30
#200 (75-μm)	71	29

Hydrometer Analysis

35-μm	3
23-μm	3
13-μm	2
9-μm	2
7-μm	1
3.4-μm	1
Colloids (<1-μm)	1



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-10 @ 11.5 - 16.5'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

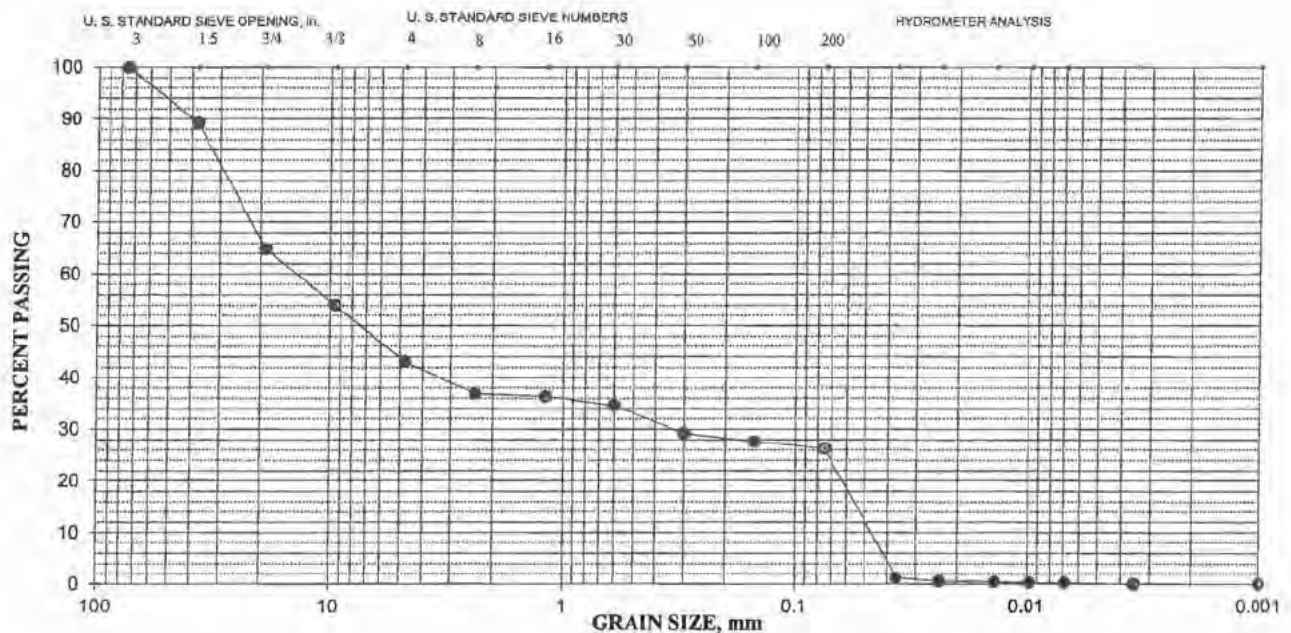
LL = 0; PL = 0; PI = 0

Gravel = 57%; Sand = 17%; Silt = 26%; Clay = 0%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	11	89
3/4" (19.0-mm)	35	65
3/8" (9.5-mm)	46	54
#4 (4.75-mm)	57	43
#8 (2.36-mm)	63	37
#16 (1.18-mm)	64	36
#30 (600- μ m)	65	35
#50 (300- μ m)	71	29
#100 (150- μ m)	72	28
#200 (75- μ m)	74	26

Hydrometer Analysis

36- μ m	1
24- μ m	1
14- μ m	0
10- μ m	0
7- μ m	0
3.5- μ m	0
Colloids (<1- μ m)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-11 @ 16.5 - 21.5'

September 20, 2012

Light Brown Sandy Lean Clay (CL)

Specific Gravity = 2.65 (assumed)

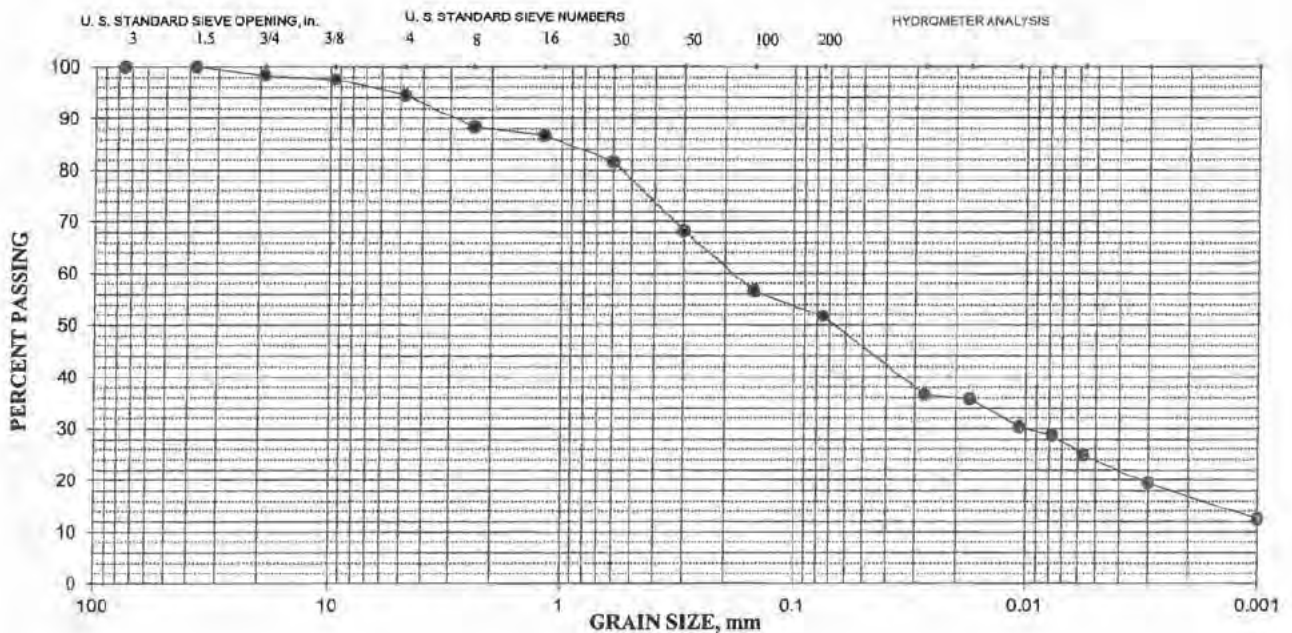
LL = 27; PL = 8; PI = 19

Gravel = 6%; Sand = 42%; Silt = 33%; Clay = 19%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	2	98
3/8" (9.5-mm)	2	98
#4 (4.75-mm)	6	94
#8 (2.36-mm)	12	88
#16 (1.18-mm)	13	87
#30 (600-μm)	18	82
#50 (300-μm)	32	68
#100 (150 μm)	43	57
#200 (75-μm)	48	52

Hydrometer Analysis

27-μm	37
17-μm	36
11-μm	30
8-μm	29
6-μm	25
3.0-μm	19
Colloids (<1-μm)	12



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-12 @ 21.5 - 26.5'

September 20, 2012

Light Brown Silty Sand with Gravel (SM)

Specific Gravity = 2.65 (assumed)

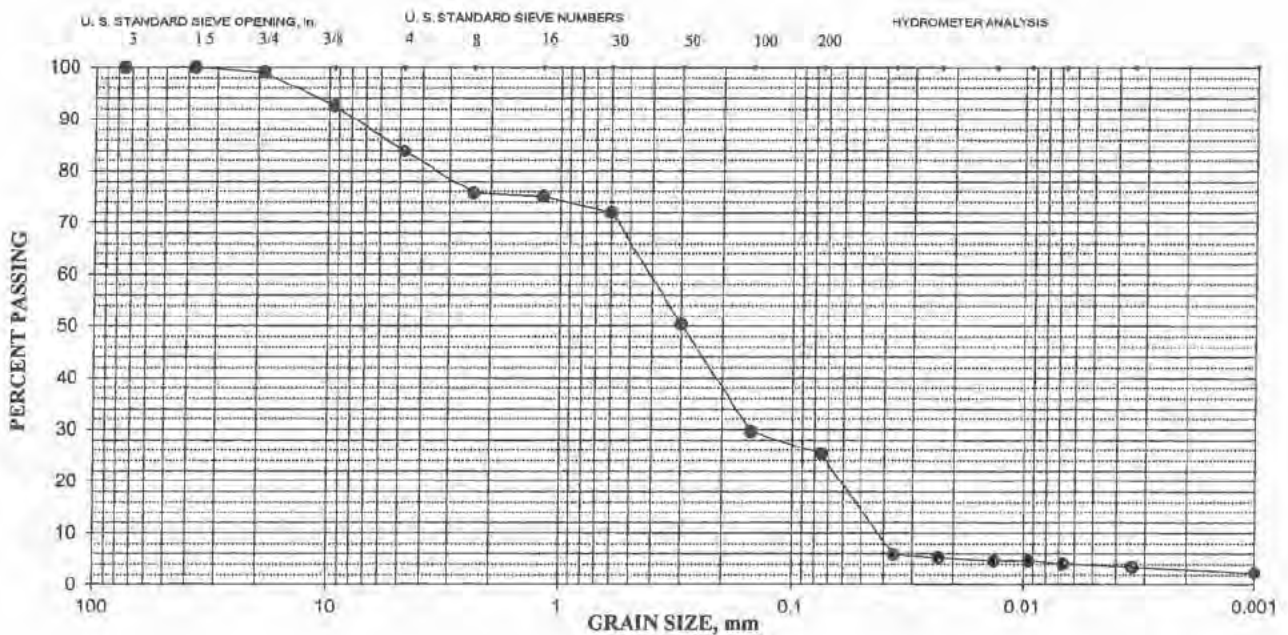
LL = 0; PL = 0; PI = 0

Gravel = 16%; Sand = 59%; Silt = 22%; Clay = 3%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	1	99
3/8" (9.5-mm)	7	93
#4 (4.75-mm)	16	84
#8 (2.36-mm)	24	76
#16 (1.18-mm)	25	75
#30 (600-μm)	28	72
#50 (300-μm)	50	50
#100 (150-μm)	70	30
#200 (75-μm)	75	25

Hydrometer Analysis

36-μm	6
23-μm	5
13-μm	5
9-μm	5
7-μm	4
3.4-μm	3
Colloids (<1-μm)	2



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-13 @ 26.5 - 31.5'

September 20, 2012

Light Brown Lean Clay with Sand (CL)

Specific Gravity = 2.65 (assumed)

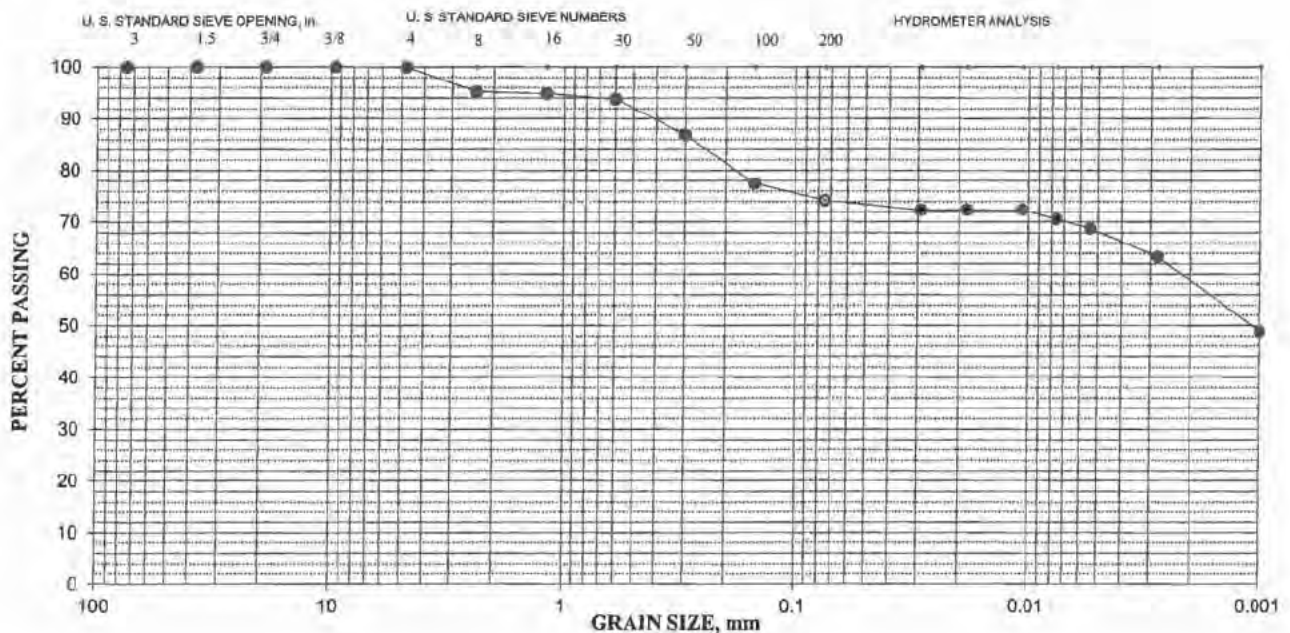
LL = 49; PL = 11; PI = 38

Gravel = 0%; Sand = 26%; Silt = 11%; Clay = 63%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	0	100
#8 (2.36-mm)	5	95
#16 (1.18-mm)	5	95
#30 (600-μm)	6	94
#50 (300-μm)	13	87
#100 (150-μm)	23	77
#200 (75-μm)	26	74

Hydrometer Analysis

29-μm	72
18-μm	72
11-μm	72
8-μm	71
5-μm	69
2.8-μm	63
Colloids (<1-μm)	49



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-14 @ 31.5 - 36.5'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

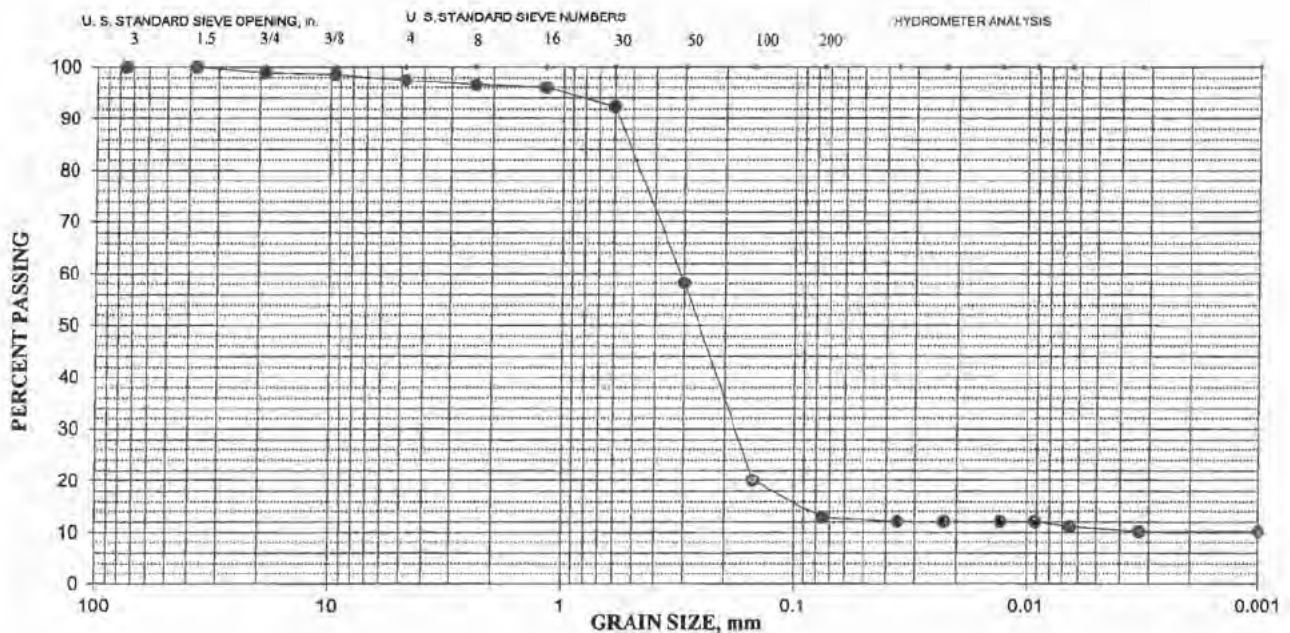
LL = 0; PL = 0; PI = 0

Gravel = 3%; Sand = 84%; Silt = 3%; Clay = 10%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	1	99
3/8" (9.5-mm)	1	99
#4 (4.75-mm)	3	97
#8 (2.36-mm)	4	96
#16 (1.18-mm)	4	96
#30 (600-μm)	8	92
#50 (300-μm)	42	58
#100 (150-μm)	80	20
#200 (75-μm)	87	13

Hydrometer Analysis

35-μm	12
22-μm	12
13-μm	12
9-μm	12
7-μm	11
3.3-μm	10
Colloids (<1-μm)	10



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #2; S-15 @ 36.5 - 41.5'

September 20, 2012

Light Brown Poorly Graded Sand with Silt (SP-SM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

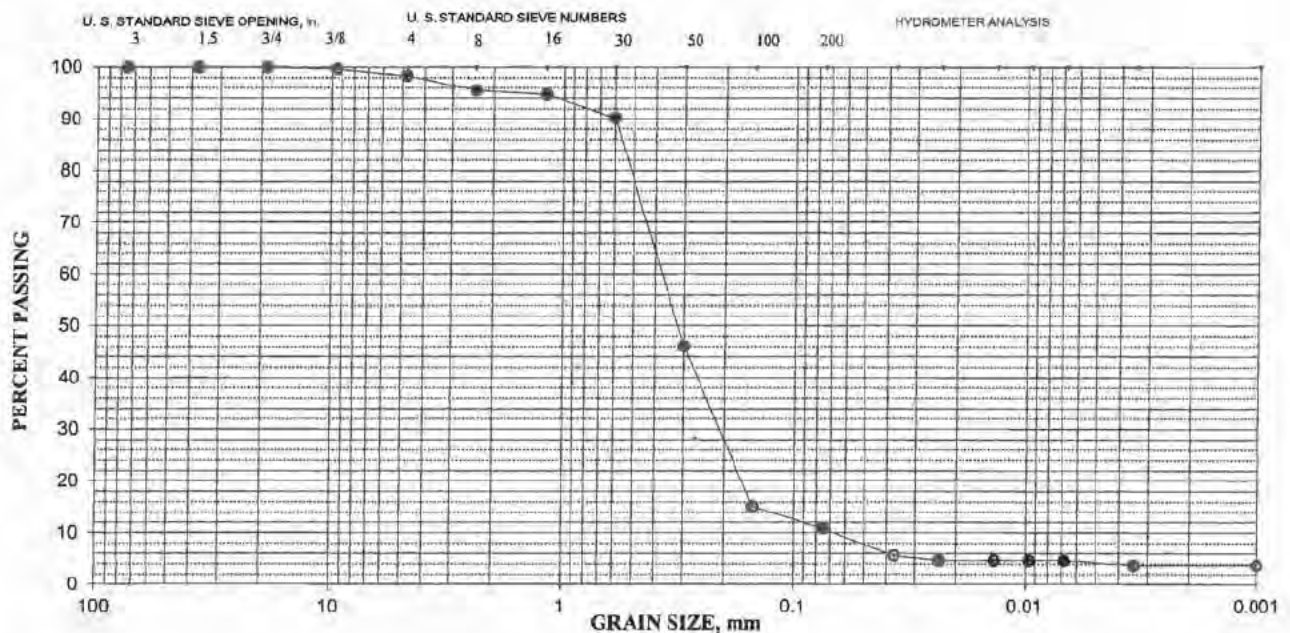
Gravel = 2%; Sand = 87%; Silt = 7%; Clay = 4%

Cu = 5.6; Cc = 1.7

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	2	98
#8 (2.36-mm)	4	96
#16 (1.18-mm)	5	95
#30 (600-μm)	10	90
#50 (300-μm)	54	46
#100 (150-μm)	85	15
#200 (75-μm)	89	11

Hydrometer Analysis

37-μm	6
23-μm	5
14-μm	5
10-μm	5
7-μm	5
3.4-μm	4
Colloids (<1-μm)	4



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-16 @ 0.0 - 1.0'

September 20, 2012

Light Brown Silty Gravel (GM)

Specific Gravity = 2.65 (assumed)

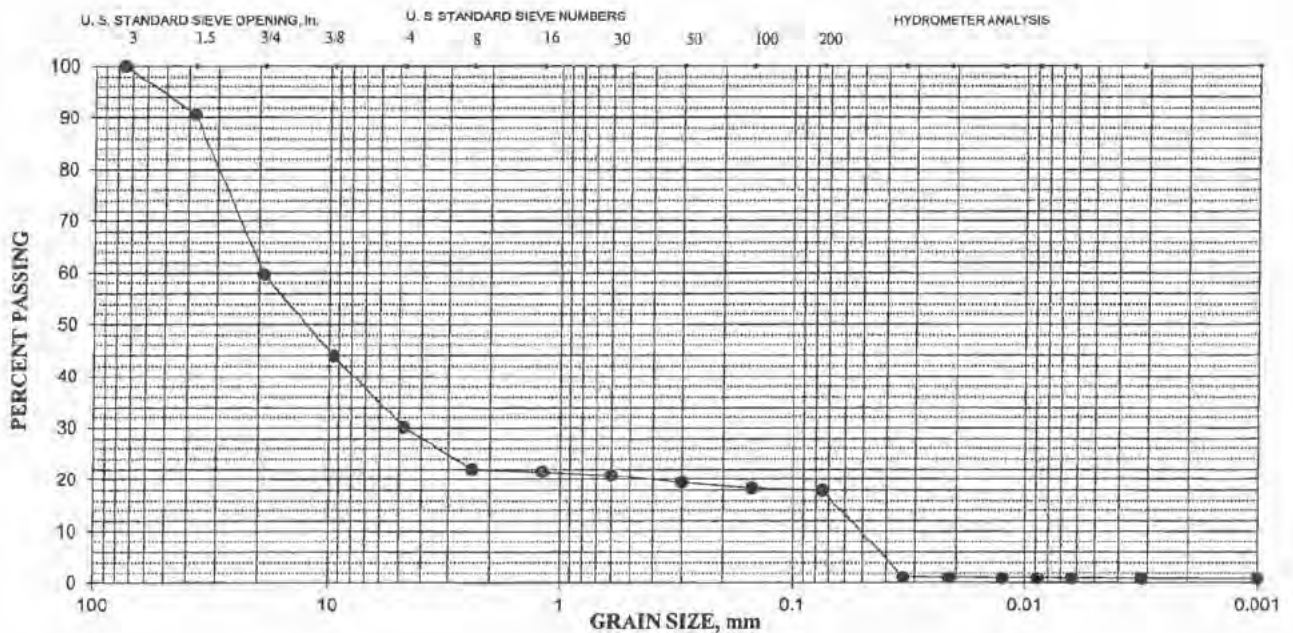
LL = 0; PL = 0; PI = 0

Gravel = 70%; Sand = 12%; Silt = 17%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	9	91
3/4" (19.0-mm)	40	60
3/8" (9.5-mm)	56	44
#4 (4.75-mm)	70	30
#8 (2.36-mm)	78	22
#16 (1.18-mm)	78	22
#30 (600-μm)	79	21
#50 (300-μm)	81	19
#100 (150-μm)	82	18
#200 (75-μm)	82	18

Hydrometer Analysis

33-μm	1
21-μm	1
12-μm	1
9-μm	1
6-μm	1
3.2-μm	1
Colloids (<1-μm)	1



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-17 @ 1.0 - 5.0'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

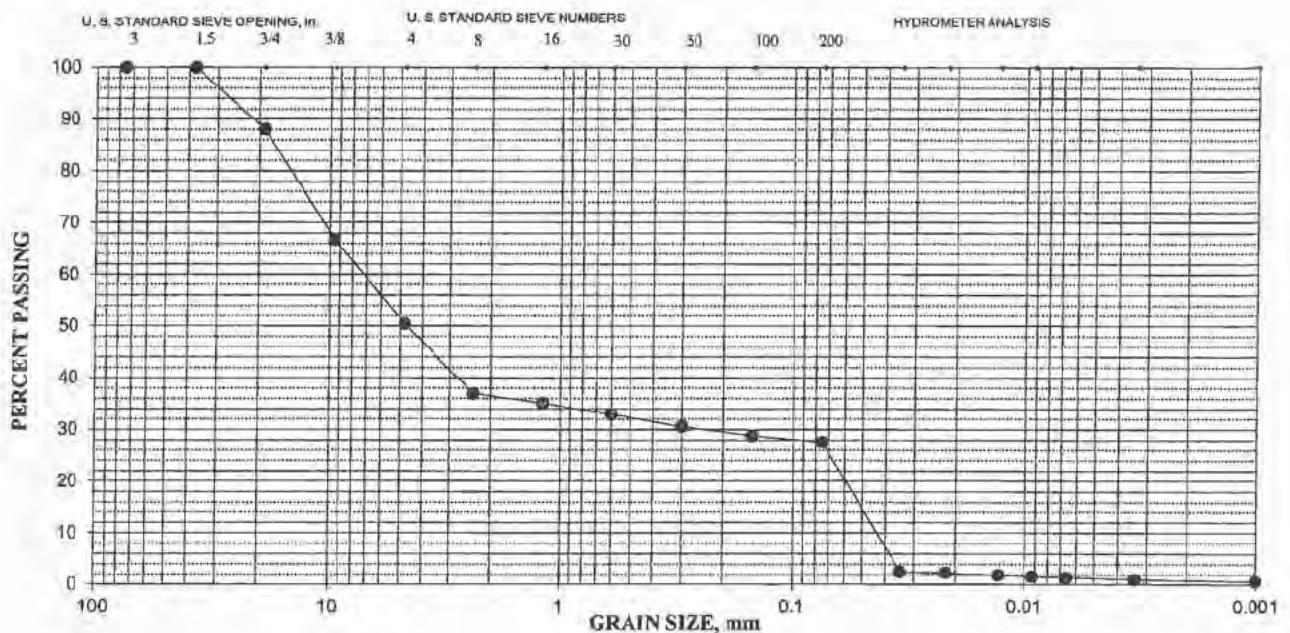
LL = 0; PL = 0; PI = 0

Gravel = 50%; Sand = 22%; Silt = 27%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	12	88
3/8" (9.5-mm)	33	67
#4 (4.75-mm)	50	50
#8 (2.36-mm)	63	37
#16 (1.18-mm)	65	35
#30 (600- μ m)	67	33
#50 (300- μ m)	69	31
#100 (150- μ m)	71	29
#200 (75- μ m)	72	28

Hydrometer Analysis

34- μ m	2
22- μ m	2
13- μ m	2
9- μ m	2
7- μ m	1
3.4- μ m	1
Colloids (<1- μ m)	1



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-18 @ 5.0 - 10.0'

September 20, 2012

Light Brown Poorly Graded Gravel with Silt and Sand (GP-GM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

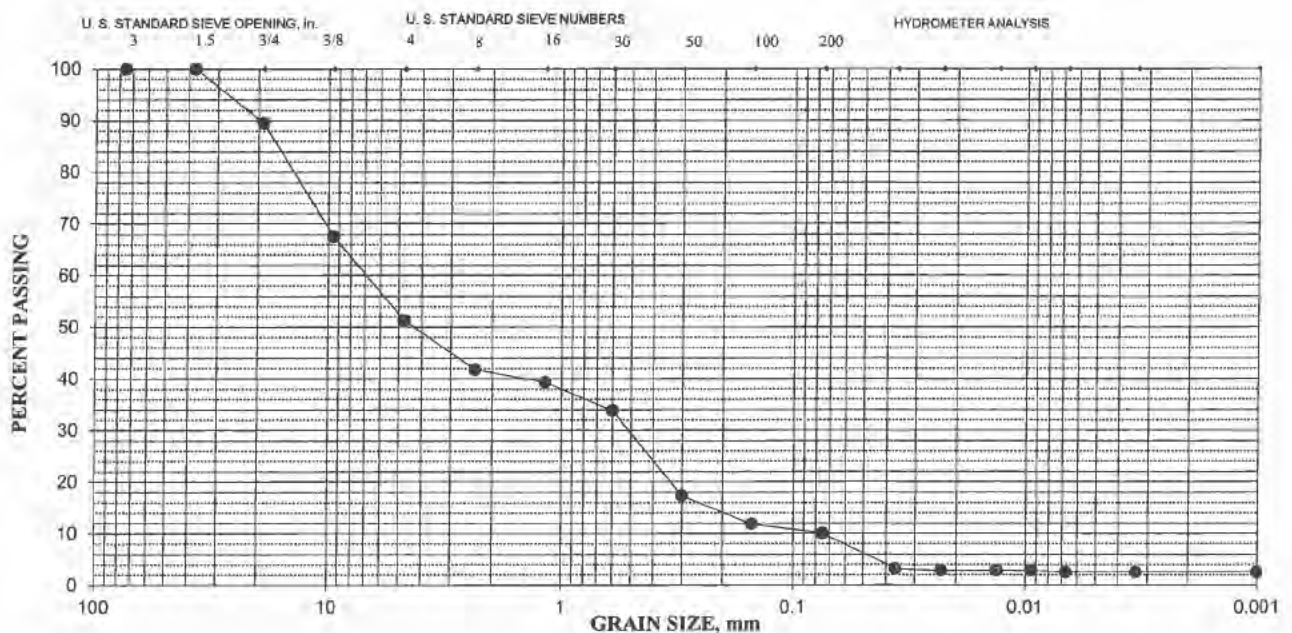
Gravel = 49%; Sand = 41%; Silt = 8%; Clay = 2%

Cu = 91.9; Cc = 0.5

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	11	89
3/8" (9.5-mm)	32	68
#4 (4.75-mm)	49	51
#8 (2.36-mm)	58	42
#16 (1.18-mm)	61	39
#30 (600-μm)	66	34
#50 (300-μm)	83	17
#100 (150-μm)	88	12
#200 (75-μm)	90	10

Hydrometer Analysis

36-μm	3
23-μm	3
13-μm	3
9-μm	3
7-μm	2
3.4-μm	2
Colloids (<1-μm)	2



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-19 @ 10.0 - 15.0'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

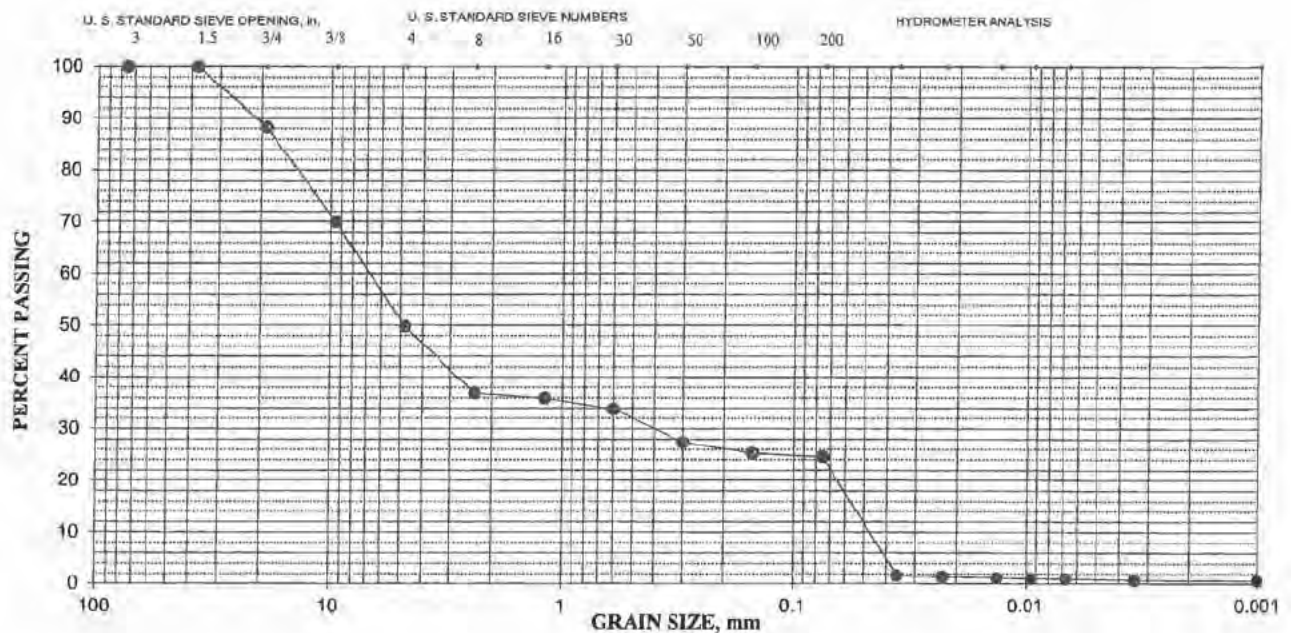
LL = 0; PL = 0; PI = 0

Gravel = 50%; Sand = 25%; Silt = 24%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	12	88
3/8" (9.5-mm)	30	70
#4 (4.75-mm)	50	50
#8 (2.36-mm)	63	37
#16 (1.18-mm)	64	36
#30 (600-μm)	66	34
#50 (300-μm)	73	27
#100 (150-μm)	75	25
#200 (75-μm)	75	25

Hydrometer Analysis

36-μm	1
23-μm	1
13-μm	1
9-μm	1
7-μm	1
3.4-μm	1
Colloids (<1-μm)	1



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-20 @ 15.0 - 20.0'

September 20, 2012

Light Brown Silty Gravel (GM)

Specific Gravity = 2.65 (assumed)

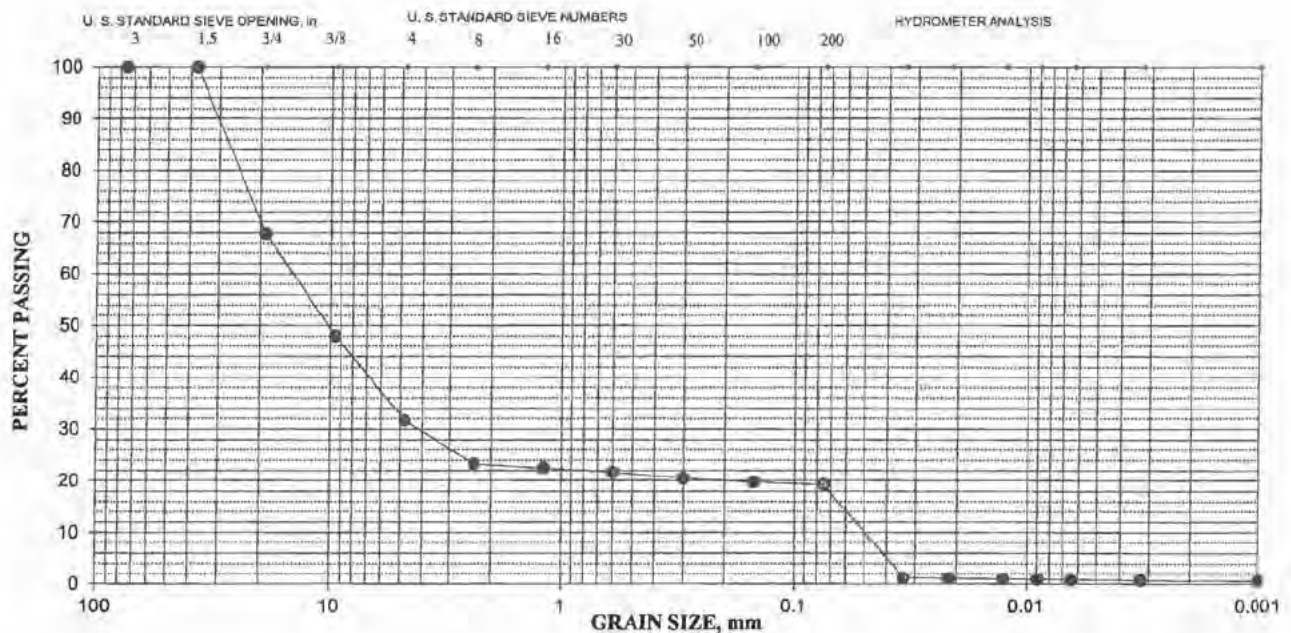
LL = 0; PL = 0; PI = 0

Gravel = 68%; Sand = 13%; Silt = 18%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	32	68
3/8" (9.5-mm)	52	48
#4 (4.75-mm)	68	32
#8 (2.36-mm)	77	23
#16 (1.18-mm)	78	22
#30 (600-μm)	78	22
#50 (300-μm)	80	20
#100 (150-μm)	80	20
#200 (75-μm)	81	19

Hydrometer Analysis

33-μm	1
21-μm	1
13-μm	1
9-μm	1
6-μm	1
3.2-μm	1
Colloids (<1-μm)	1



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-21 @ 20.0 - 25.0'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

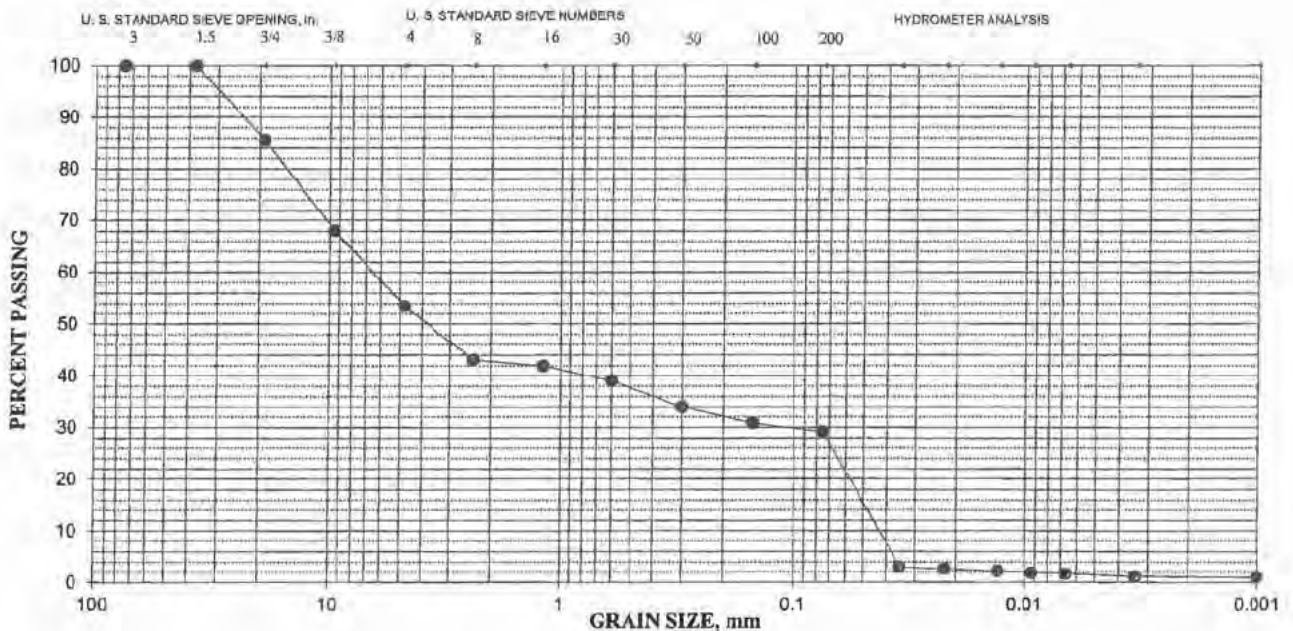
LL = 0; PL = 0; PI = 0

Gravel = 47%; Sand = 24%; Silt = 28%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	14	86
3/8" (9.5-mm)	32	68
#4 (4.75-mm)	47	53
#8 (2.36-mm)	57	43
#16 (1.18-mm)	58	42
#30 (600-μm)	61	39
#50 (300-μm)	66	34
#100 (150-μm)	69	31
#200 (75-μm)	71	29

Hydrometer Analysis

35-μm	3
22-μm	3
13-μm	2
9-μm	2
7-μm	2
3.4-μm	1
Colloids (<1-μm)	1



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-22 @ 25.0 - 30.0'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

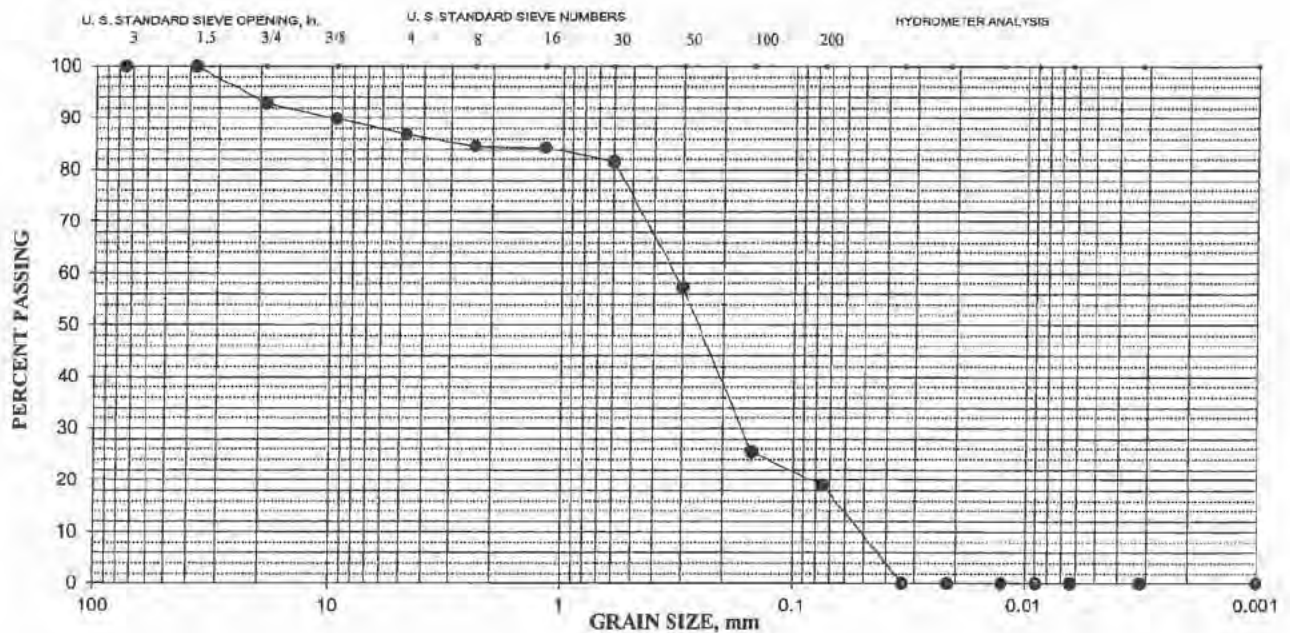
LL = 0; PL = 0; PI = 0

Gravel = 13%; Sand = 68%; Silt = 19%; Clay = 0%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	7	93
3/8" (9.5-mm)	10	90
#4 (4.75-mm)	13	87
#8 (2.36-mm)	15	85
#16 (1.18-mm)	16	84
#30 (600- μ m)	18	82
#50 (300- μ m)	43	57
#100 (150- μ m)	75	25
#200 (75- μ m)	81	19

Hydrometer Analysis

34- μ m	0
22- μ m	0
13- μ m	0
9- μ m	0
6- μ m	0
3.2- μ m	0
Colloids (<1- μ m)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-23 @ 30.0 - 35.0'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

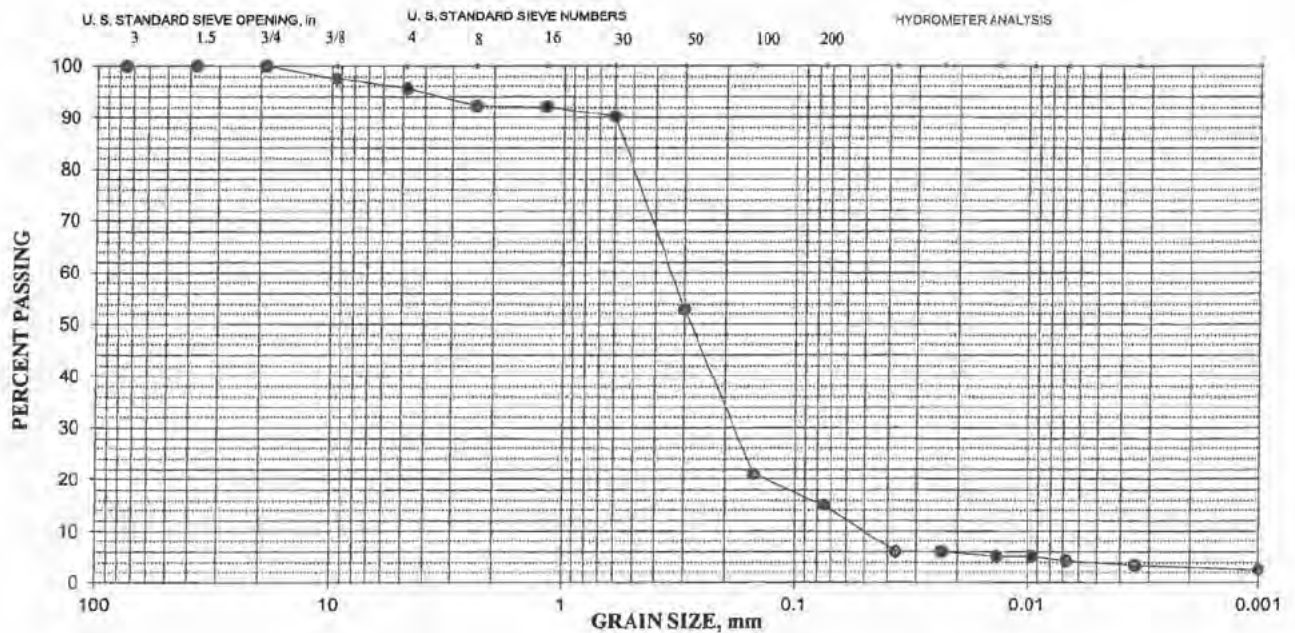
LL = 0; PL = 0; PI = 0

Gravel = 4%; Sand = 81%; Silt = 12%; Clay = 3%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	3	97
#4 (4.75-mm)	4	96
#8 (2.36-mm)	8	92
#16 (1.18-mm)	8	92
#30 (600- μ m)	10	90
#50 (300- μ m)	47	53
#100 (150- μ m)	79	21
#200 (75- μ m)	85	15

Hydrometer Analysis

37- μ m	6
23- μ m	6
14- μ m	5
10- μ m	5
7- μ m	4
3.4- μ m	3
Colloids (<1- μ m)	3



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #3; S-24 @ 35.0 - 40.0'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

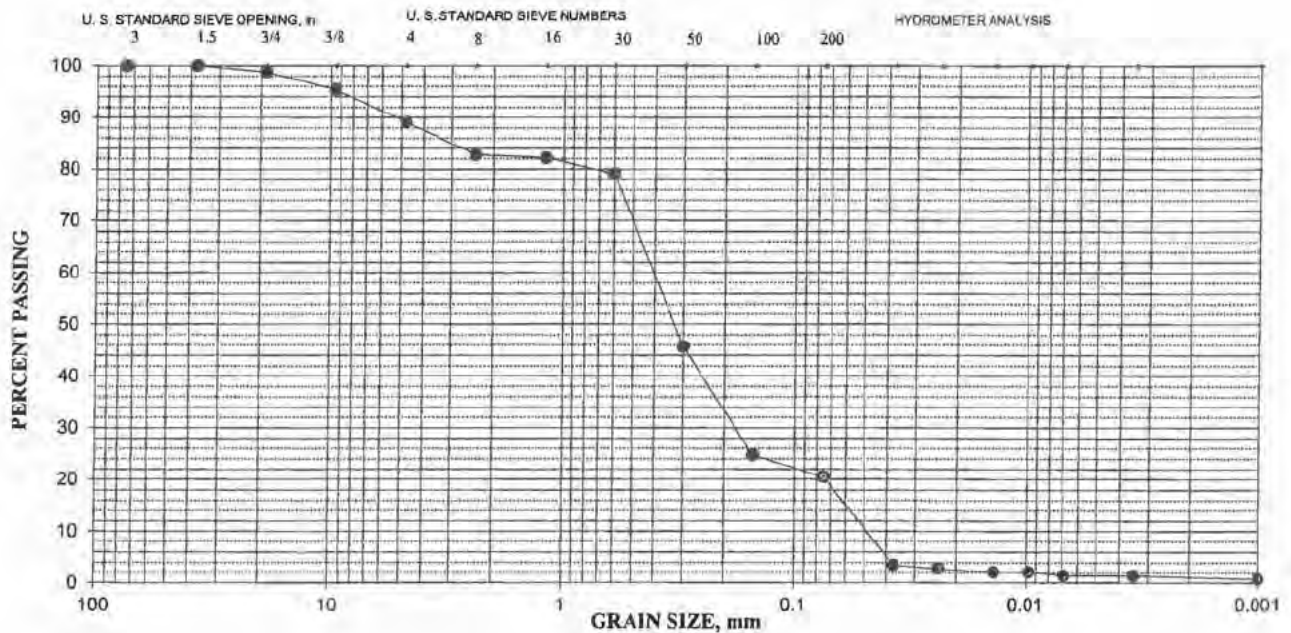
LL = 0; PL = 0; PI = 0

Gravel = 11%; Sand = 68%; Silt = 20%; Clay = 1%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	1	99
3/8" (9.5-mm)	5	95
#4 (4.75-mm)	11	89
#8 (2.36-mm)	17	83
#16 (1.18-mm)	18	82
#30 (600- μ m)	21	79
#50 (300- μ m)	54	46
#100 (150- μ m)	75	25
#200 (75- μ m)	79	21

Hydrometer Analysis

37- μ m	3
24- μ m	3
14- μ m	2
10- μ m	2
7- μ m	1
3.4- μ m	1
Colloids (<1- μ m)	1



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-25 @ 0.0 - 1.0'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

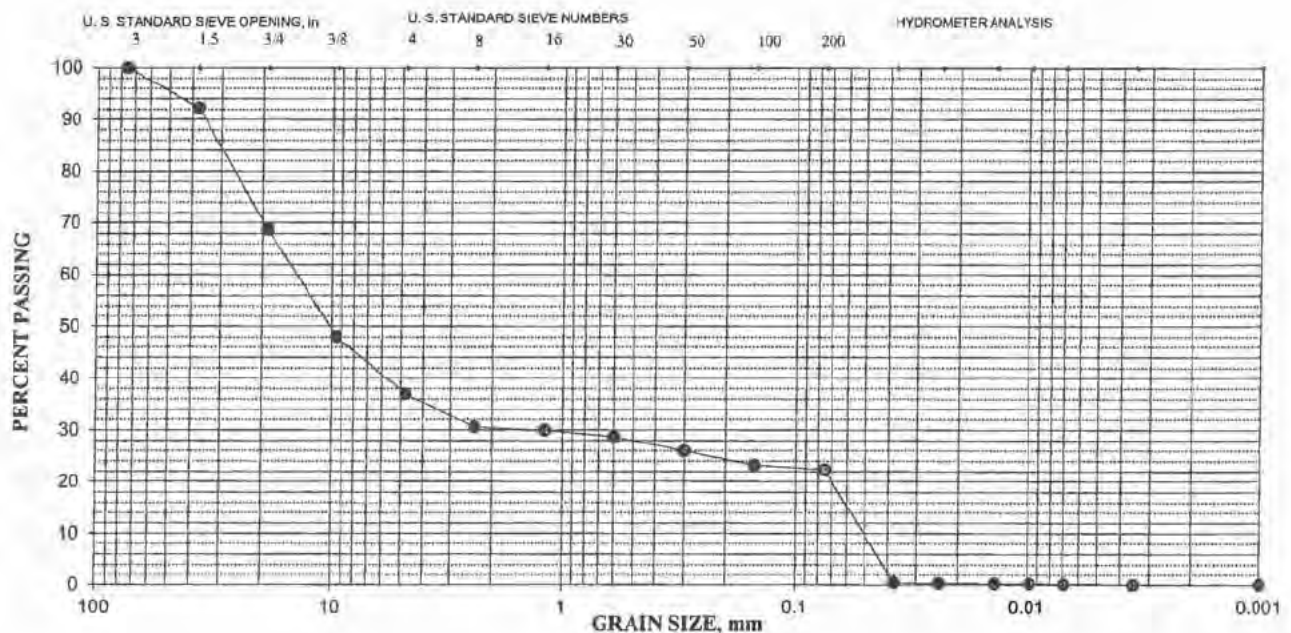
LL = 0; PL = 0; PI = 0

Gravel = 63%; Sand = 15%; Silt = 22%; Clay = 0%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	8	92
3/4" (19.0-mm)	31	69
3/8" (9.5-mm)	52	48
#4 (4.75-mm)	63	37
#8 (2.36-mm)	69	31
#16 (1.18-mm)	70	30
#30 (600- μ m)	71	29
#50 (300- μ m)	74	26
#100 (150- μ m)	77	23
#200 (75- μ m)	78	22

Hydrometer Analysis

37- μ m	0
24- μ m	0
14- μ m	0
10- μ m	0
7- μ m	0
3.5- μ m	0
Colloids (<1- μ m)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-26 @ 1.0 - 4.0'

September 20, 2012

Light Brown Silty Gravel (GM)

Specific Gravity = 2.65 (assumed)

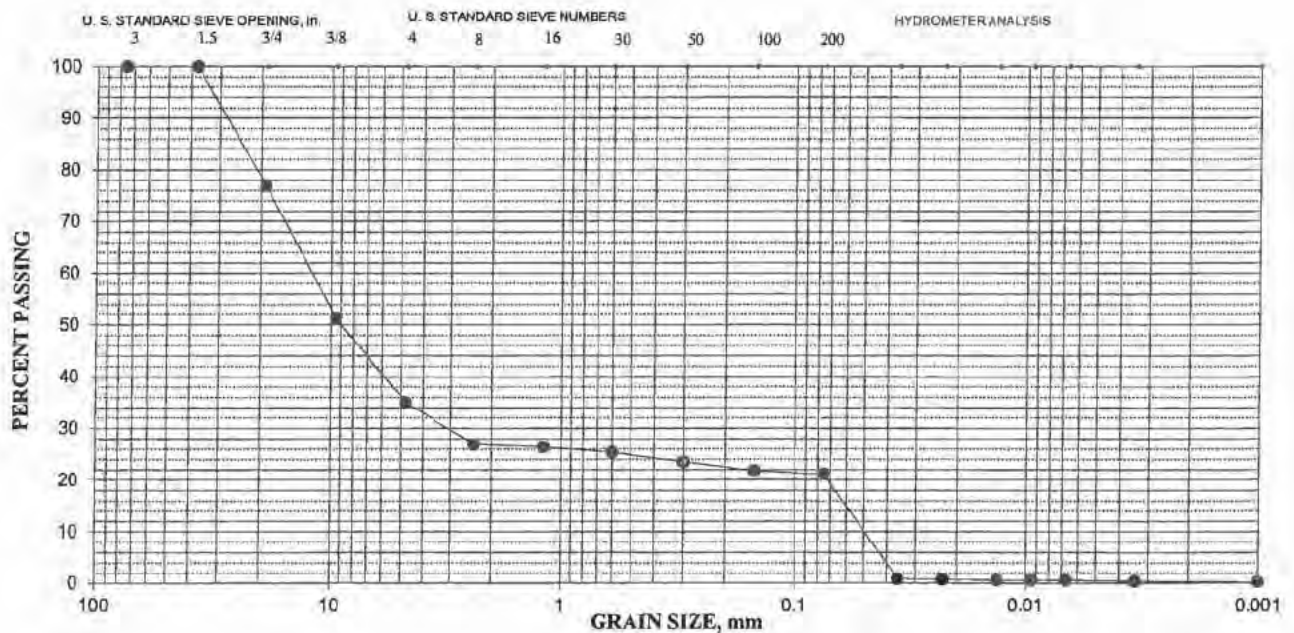
LL = 0; PL = 0; PI = 0

Gravel = 65%; Sand = 14%; Silt = 21%; Clay = 0%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	23	77
3/8" (9.5-mm)	49	51
#4 (4.75-mm)	65	35
#8 (2.36-mm)	73	27
#16 (1.18-mm)	74	26
#30 (600- μ m)	75	25
#50 (300- μ m)	77	23
#100 (150- μ m)	78	22
#200 (75- μ m)	79	21

Hydrometer Analysis

36- μ m	1
23- μ m	1
13- μ m	1
9- μ m	1
7- μ m	1
3.4- μ m	0
Colloids (<1- μ m)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-27 @ 4.0 - 9.0'

September 20, 2012

Light Brown Silty Gravel with Sand (GM)

Specific Gravity = 2.65 (assumed)

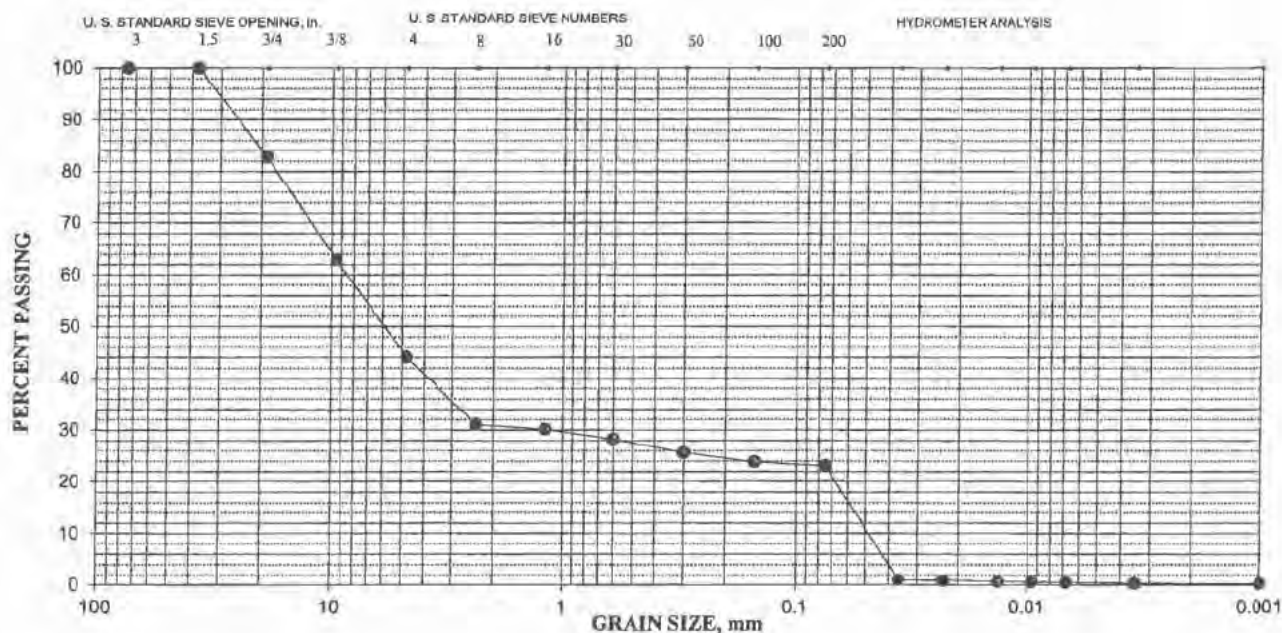
LL = 0; PL = 0; PI = 0

Gravel = 56%; Sand = 21%; Silt = 23%; Clay = 0%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	17	83
3/8" (9.5-mm)	37	63
#4 (4.75-mm)	56	44
#8 (2.36-mm)	69	31
#16 (1.18-mm)	70	30
#30 (600-μm)	72	28
#50 (300-μm)	74	26
#100 (150-μm)	76	24
#200 (75-μm)	77	23

Hydrometer Analysis

36-μm	1
23-μm	1
13-μm	1
10-μm	1
7-μm	0
3.4-μm	0
Colloids (<1-μm)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-28 @ 9.0 - 16.5'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

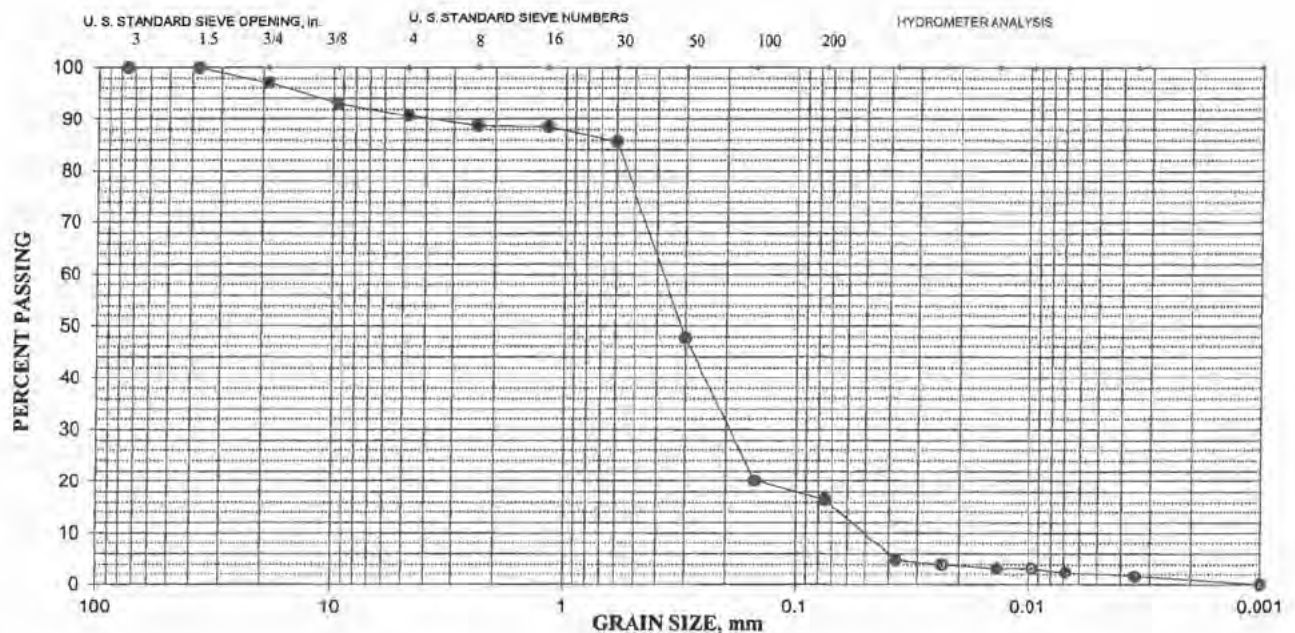
LL = 0; PL = 0; PI = 0

Gravel = 9%; Sand = 74%; Silt = 15%; Clay = 2%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	3	97
3/8" (9.5-mm)	7	93
#4 (4.75-mm)	9	91
#8 (2.36-mm)	11	89
#16 (1.18-mm)	11	89
#30 (600-μm)	14	86
#50 (300-μm)	52	48
#100 (150-μm)	80	20
#200 (75-μm)	83	17

Hydrometer Analysis

37-μm	5
23-μm	4
14-μm	3
10-μm	3
7-μm	2
3.4-μm	2
Colloids (<1-μm)	0



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-29 @ 16.5 - 21.5'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

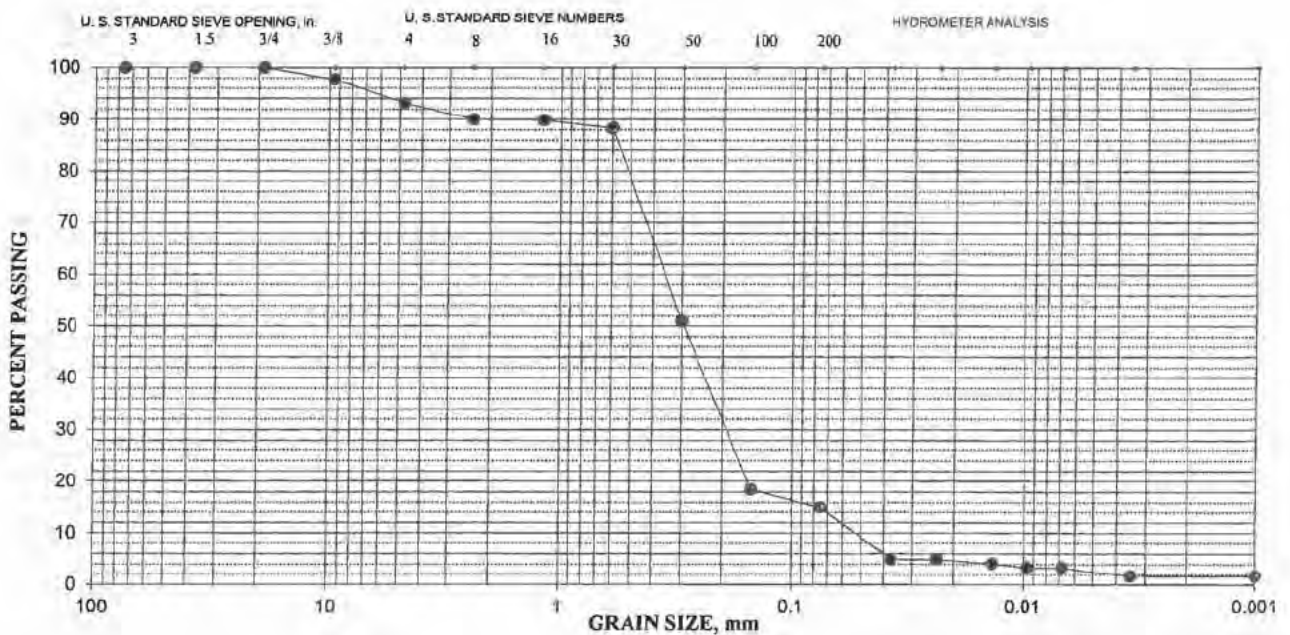
LL = 0; PL = 0; PI = 0

Gravel = 7%; Sand = 78%; Silt = 13%; Clay = 2%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	2	98
#4 (4.75-mm)	7	93
#8 (2.36-mm)	10	90
#16 (1.18-mm)	10	90
#30 (600-μm)	12	88
#50 (300-μm)	49	51
#100 (150-μm)	82	18
#200 (75-μm)	85	15

Hydrometer Analysis

37-μm	5
23-μm	5
14-μm	4
10-μm	3
7-μm	3
3.4-μm	2
Colloids (<1-μm)	2



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-30 @ 21.5 - 26.5'

September 20, 2012

Light Brown Poorly Graded Sand with Silt (SP-SM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

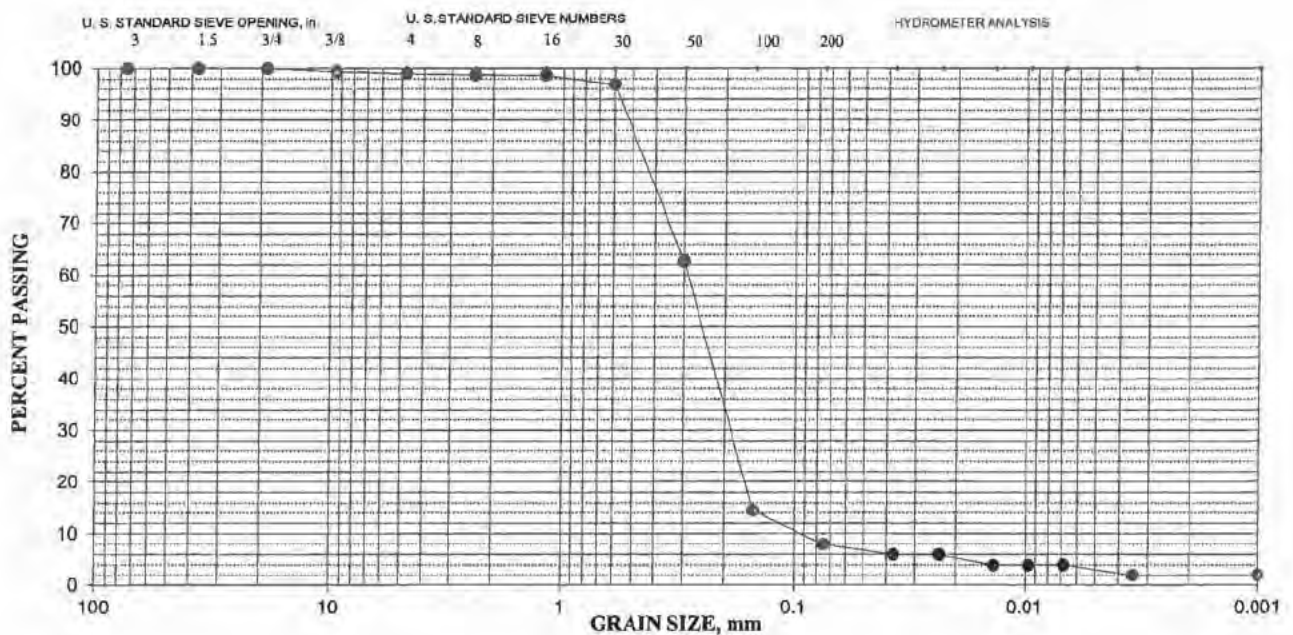
Gravel = 1%; Sand = 91%; Silt = 6%; Clay = 2%

Cu = 3.1; Cc = 1.3

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	1	99
#4 (4.75-mm)	1	99
#8 (2.36-mm)	1	99
#16 (1.18-mm)	1	99
#30 (600-μm)	3	97
#50 (300-μm)	37	63
#100 (150-μm)	86	14
#200 (75-μm)	92	8

Hydrometer Analysis

37-μm	6
23-μm	6
14-μm	4
10-μm	4
7-μm	4
3.4-μm	2
Colloids (<1-μm)	2



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-31 @ 26.5 - 31.5'

September 20, 2012

Light Brown Silty Sand (SM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

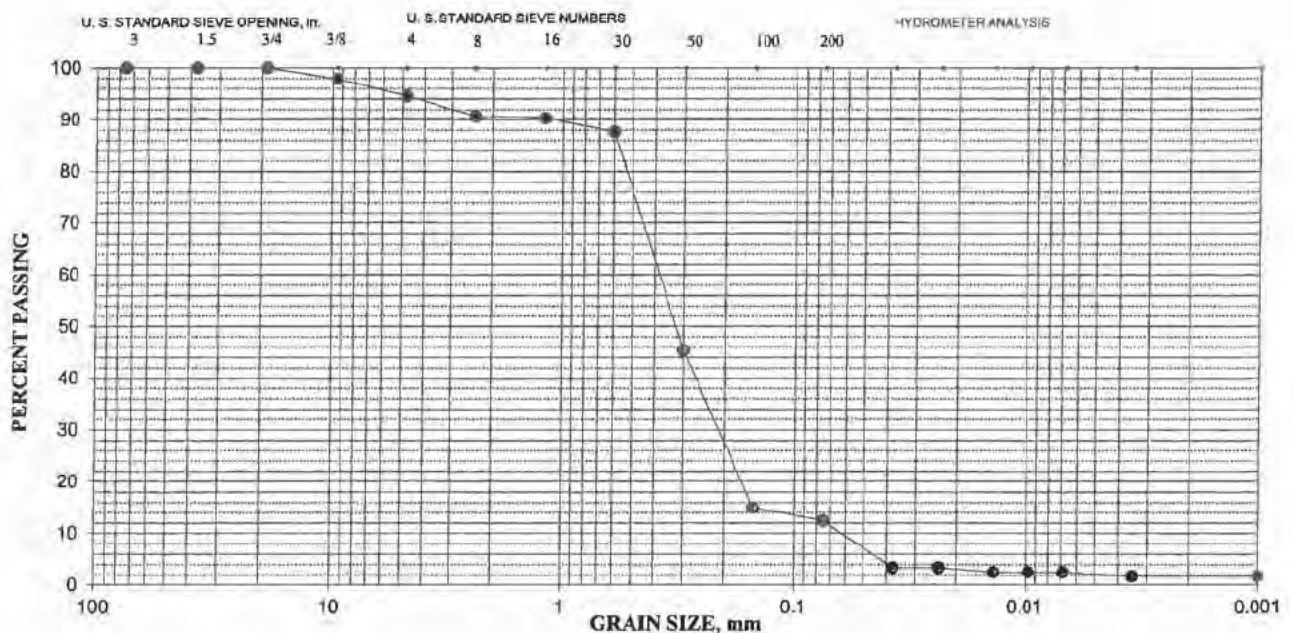
Gravel = 5%; Sand = 83%; Silt = 10%; Clay = 2%

Cu = 6.1; Cc = 1.9

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	2	98
#4 (4.75-mm)	5	95
#8 (2.36-mm)	9	91
#16 (1.18-mm)	10	90
#30 (600-μm)	12	88
#50 (300-μm)	55	45
#100 (150-μm)	85	15
#200 (75-μm)	88	12

Hydrometer Analysis

37-μm	3
24-μm	3
14-μm	2
10-μm	2
7-μm	2
3.4-μm	2
Colloids (<1-μm)	2



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-32 @ 31.5 - 36.5'

September 20, 2012

Light Brown Poorly Graded Sand with Silt (SP-SM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

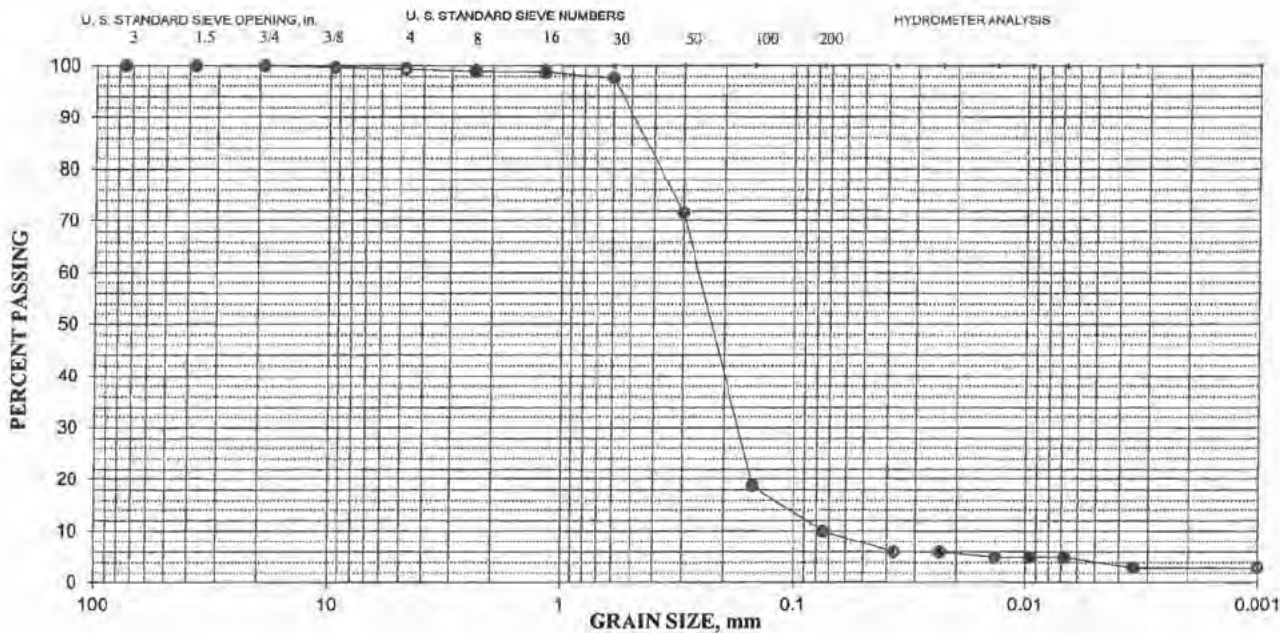
Gravel = 1%; Sand = 89%; Silt = 7%; Clay = 3%

Cu = 3.4; Cc = 1.6

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	1	99
#8 (2.36-mm)	1	99
#16 (1.18-mm)	1	99
#30 (600-μm)	2	98
#50 (300-μm)	29	71
#100 (150-μm)	81	19
#200 (75-μm)	90	10

Hydrometer Analysis

37-μm	6
23-μm	6
14-μm	5
10-μm	5
7-μm	5
3.4-μm	3
Colloids (<1-μm)	3



PARTICLE-SIZE ANALYSIS of SOILS

ASTM D 422-02

Boring #4; S-32 @ 36.5 - 41.5'

September 20, 2012

Light Brown Silty Sand with Gravel (SM)

Specific Gravity = 2.65 (assumed)

LL = 0; PL = 0; PI = 0

Gravel = 15%; Sand = 64%; Silt = 21%; Clay = 0%

Sieve Size	% Retained	% Passing
3" (75.0-mm)	0	100
1-1/2" (37.5-mm)	0	100
3/4" (19.0-mm)	4	96
3/8" (9.5-mm)	7	93
#4 (4.75-mm)	15	85
#8 (2.36-mm)	21	79
#16 (1.18-mm)	22	78
#30 (600- μ m)	25	75
#50 (300- μ m)	54	46
#100 (150- μ m)	77	23
#200 (75- μ m)	79	21

Hydrometer Analysis

38- μ m	2
24- μ m	2
14- μ m	2
10- μ m	2
7- μ m	1
3.5- μ m	0
Colloids (<1- μ m)	0

